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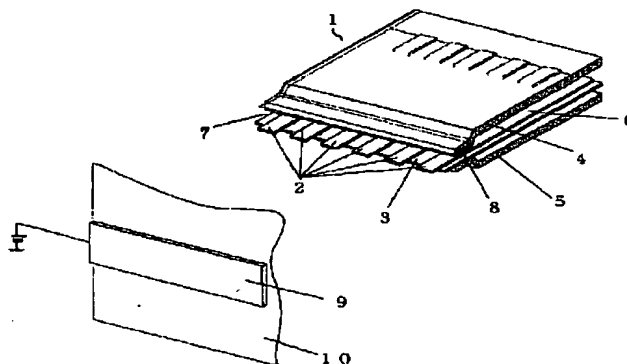
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(54) 【発明の名称】 インクジェットインク、それを用いた静電型インクジェット記録方法及び記録装置

(57) 【要約】

【課題】 優れた印字性能を有し、さらに一般の家庭やオフィス環境での使用に適したインクジェットインク、それを用いた静電型インクジェット記録方法及び装置を提供する事を目的とする。

【解決手段】 本発明のインクジェットインクは、電気絶縁性の非水溶媒中に、少なくとも前記非水溶媒に不溶性色材を含有する構成を有し、 $10^6 \Omega \cdot m$ 以上の体積抵抗率を有するインクジェットインクであって、前記溶媒がアニリン点 $77 \sim 92^\circ C$ の炭化水素系溶剤である事を特徴とする。



【特許請求の範囲】

【請求項 1】電気絶縁性の非水溶媒中に、少なくとも前記非水溶媒に不溶な色材を含有する構成を有し、 $10^6 \Omega \cdot m$ 以上の体積抵抗率を有するインクジェットインクであって、前記溶媒がアニリン点 $77 \sim 92^\circ C$ の炭化水素系溶剤である事の特徴とするインクジェットインク。

【請求項 2】前記炭化水素系溶剤の沸点範囲が、 $150 \sim 260^\circ C$ であることを特徴とする請求項 1 記載のインクジェットインク。

【請求項 3】前記炭化水素系溶剤がノルマルパラフィン類、イソパラフィン類もしくはそれらの混合物である事を特徴とする請求項 1, 2 いずれか 1 記載のインクジェットインク。

【請求項 4】アニリン点 $77 \sim 92^\circ C$ 、沸点範囲 $150 \sim 260^\circ C$ の、ノルマルパラフィン類、イソパラフィン類もしくはそれらの混合物を溶媒とし、少なくとも前記溶媒に不溶な色材を含有する構成を有し、 $10^7 \Omega \cdot m$ 以上の体積抵抗率を有する事を特徴とするインクジェットインク。

【請求項 5】請求項 1～4 いずれか 1 記載のインクジェットインクを記録電極が配置された記録ヘッドに導入し、前記記録電極と前記記録電極に対向して配置された対向電極との間に電圧を印加し前記インクに静電力を作用させることで、前記記録ヘッドより前記インクを飛翔させ前記記録電極と前記対向電極との間に配置された記録媒体上に印字ドットを形成し記録を行う事を特徴とする静電型インクジェット記録方法。

【請求項 6】少なくとも記録電極が配置された記録ヘッドと、前記記録電極に対向して配置された対向電極とを有し、請求項 1～4 いずれか 1 記載のインクジェットインクを前記記録電極が配置された記録ヘッドに導入し、前記記録電極と前記記録電極に対向して配置された対向電極との間に電圧を印加し前記インクに静電力を作用させることで、前記記録ヘッドより前記インクを飛翔させ前記記録電極と前記対向電極との間に配置された記録媒体上に印字ドットを形成し記録を行う事を特徴とする静電型インクジェット記録装置。

【発明の詳細な説明】**【0001】**

【発明の属する技術分野】本発明は、インクジェットインク、それを用いた静電型インクジェット記録方法及び記録装置に関するものである。

【0002】

【従来の技術】インクを記録媒体に飛翔させ記録ドットを形成することにより印字を行うインクジェット記録法は、カラー化が容易で普通紙に直接記録できるノンインパクト記録法として関心を集めており、この方式を用いたプリンターが種々実用化されている。インクジェット記録法の一つとして、記録媒体に対向して配置された複数の記録電極と記録媒体の背面に配置された対向電極と

に電圧を印加し、両電極間に生じた電位差により、記録電極上に供給されたインクに静電力を作用させ、インクを記録媒体上に飛翔させる、静電型のインクジェット記録法がある。これらの静電インクジェットプリンターは、例えば、“インクジェット記録技術”、株式会社トリケップス発行（1989年）に紹介されている。

【0003】このような静電インクジェット方式により構成された、ドロップオンデマンド型のフルカラー記録ヘッドの一例が、例えば特開昭58-215253号公報、電気通信学会論文誌、Vol. J68-C, 2（1985年）第93ページから第100ページに開示、発表されている。この方式は、従来のインクジェットヘッドにおけるノズルの代わりに、内壁に多数の記録電極を有する細長いスリット状のインク吐出口を用いている。このため、インクの見詰まりに対する心配が少なく、またヘッドの構成が単純であることにより製造コストの低減が期待でき、記録媒体の幅方向の広範囲をカバーできる長さの、いわゆる長尺ラインヘッドを実現するためにも有効な方法である。この静電型インクジェットヘッドにおいては、有機溶剤に染料を溶解した油性インクが好適に用いられ、インクの構成材料に関しては詳細に開示されていないが、電気通信学会論文誌、Vol. J68-C, 2, pp. 93-100,（1985年）に見られる例では、体積抵抗率（電気抵抗率）が $10^5 \sim 10^6 \Omega \cdot m$ 、表面張力が $22 mN/m$ 、粘度が $3.1 \sim 6.9 cP$ の物性値を有するインクが用いられている。しかしながら、このような油性インクは、他のインクジェット方式において一般に用いられている水性インクと比較し表面張力が低いために、記録紙への浸透性が非常に大きく、特に普通紙に印字を行う場合において、印字濃度の低下やにじみ、裏写りを生じやすいという問題があった。

【0004】これに対して、例えば特開平9-11475号公報、特開平9-118015号公報、特開平9-193389号公報等には、帯電された色材粒子（トナー）が電気絶縁性の高い液体中に分散されたインクを用い、吐出電極と対向電極との間に形成された静電界により、色材粒子を電気泳動により吐出電極先端の吐出部に集中させ、色材が高濃度に濃縮された形でインク滴を飛翔させる静電インクジェットヘッドが開示されている。この場合、通常、吐出電極には色材の帯電極性と同極性の電位を、対向電極には色材の帯電極性と逆極性の電位を与える。この方式では、その吐出原理の詳細は明らかにされていないが、前述の方式とは異なり、インクの構成成分が均一な状態で多量の液体成分を含んだまま吐出されるのではなく、色材が凝集され液体成分が少ない状態でインクが吐出されることにより、上述の問題点が解決される。また、顔料を色材として用いることにより、従来の染料を用いたインクジェットヘッドに比べ、印字画像の耐水性、耐光性に関しても有利な結果が得られ

る。

【0005】この様な色材凝集型の静電インクジェットインクにおいては、印字濃度が高く、にじみや裏写りを生じない良好な印字特性を得るためには、まず第1にインクの体積抵抗率が十分大きい事が必要である。この事により記録電極と対向電極により形成されインクに印加された電界を色材粒子に到達させる事が可能となる。また、インクの体積抵抗率が低いと、記録電極により印加される電圧により、インクが電荷注入を受け帯電してしまい、静電反発力によりインクが多量の液体成分を含んだまま吐出してしまう傾向が強くなる。次に、色材粒子を十分な速度で電気泳動により吐出口部に集中させる必要があるため、色材粒子が十分な帯電量を有している事、すなわち色材粒子が正極性もしくは負極性の高いゼータ電位を有している事が必要である。また、吐出性能と色材粒子の沈降防止との兼ね合いから、色材粒子の平均粒径は、 $0.1 \sim 4 \mu\text{m}$ 程度が好ましいとされる。

【0006】具体的には、例えば特開平9-193389号公報等には、電気抵抗率が $10^8 \Omega \cdot \text{m}$ 以上の誘電性液体中に、前記誘電性液体に対するゼータ電位が 60mV 以上であり、かつ平均粒径が 0.01 及至 $5 \mu\text{m}$ の範囲内にある現像剤粒子（少なくとも着色材成分を有する固形樹脂粒子）を分散させる事により、 $10^6 \Omega \cdot \text{m}$ 以上、最も好ましくは $10^8 \Omega \cdot \text{m}$ 以上の電気抵抗率を有するように調整されたインクの使用が開示されている。この様なインクは、例えば、絶縁性液体として $10^8 \Omega \cdot \text{m}$ 以上の体積抵抗率を有する炭化水素系溶剤、色材として、カーボンブラック顔料および有機顔料、並びに、樹脂やワックスからなるバインダ中もしくは表面に顔料を含有するものを用い、その他分散剤、帯電制御剤等を加えた系で色材分散体を作製する事により調製する事が可能と考えられるが、好適なインクの組成と材料、作製方法およびインク物性値の詳細は開示されていない。

【0007】

【発明が解決しようとする課題】上記のような色材凝集型の静電インクジェット記録方式においては、色材粒子を非水溶媒中に分散させた構成のインクを用い、スリット状の開口部を形成する基板上等に設けられた吐出電極先端の吐出部に、インク中の色材粒子を電気泳動により集中させ、色材が高濃度に濃縮された形でインク滴を飛翔させる構成のため、開口部からの非水溶媒溶媒の揮発、吐出電極への色材粒子並びに不純物の付着等により、吐出電極先端部近傍におけるインクの高粘度化や色材粒子の固着（こびりつき）等が発生し、インクの吐出が不安定になったり、インク吐出の応答周波数が低下するという問題があった。また、分子量が高く揮発性の低い溶媒を使用すると開口部からの溶媒の揮発は抑制されるが、インクの高粘度化による流動性の低下や色材粒子の泳動速度低下により、同様にインクの吐出が不安定に

なったり、インク吐出の応答周波数が低下するという問題があった。さらに、非水溶媒を用いるため、溶媒の分子構造、揮発性、不純物の含有量等の原因により臭気が発生し、特に一般の家庭やオフィス環境での使用に際し問題となる場合があった。

【0008】本発明は上記従来の問題点を解決する物であり、優れた印字性能を有し、さらに一般の家庭やオフィス環境での使用に適したインクジェットインク、それを用いた静電型インクジェット記録方法及び装置を提供する事を目的とする。

【0009】

【課題を解決するための手段】本発明のインクジェットインクは、電気絶縁性の非水溶媒中に、少なくとも前記非水溶媒に不溶な色材を含有する構成を有し、前記溶媒がアニリン点 $77 \sim 92^\circ\text{C}$ の炭化水素系溶剤である構成とした。

【0010】本発明によれば、優れた印字性能を有し、さらに一般の家庭やオフィス環境での使用に適したインクジェットインクを実現することができる。

【0011】

【発明の実施の形態】本発明の請求項1に記載の発明は、電気絶縁性の非水溶媒中に、少なくとも非水溶媒に不溶な色材を含有する構成を有し、 $10^6 \Omega \cdot \text{m}$ 以上の体積抵抗率を有するインクジェットインクであって、溶媒がアニリン点 $77 \sim 92^\circ\text{C}$ の炭化水素系溶剤である事を特徴とするインクジェットインクであり、溶媒である炭化水素系溶剤中のナフテン類や芳香族類の含有量を非常に少なくすると共に、溶剤を構成する炭化水素類の分子量を適当な範囲とするという作用を有する。

【0012】本発明の請求項2に記載の発明は、請求項1において、炭化水素系溶剤の沸点範囲が、 $150 \sim 260^\circ\text{C}$ であることを特徴とするインクジェットインクであり、室温におけるインク溶媒の揮発性および粘度を適当な範囲とするという作用を有する。

【0013】本発明の請求項3に記載の発明は、請求項1、2において、炭化水素系溶剤がノルマルパラフィン類、イソパラフィン類もしくはそれらの混合物である事を特徴とするインクジェットインクであり、インクの臭気を非常に小さくするという作用を有する。

【0014】本発明の請求項4に記載の発明は、アニリン点 $77 \sim 92^\circ\text{C}$ 、沸点範囲 $150 \sim 260^\circ\text{C}$ の、ノルマルパラフィン類、イソパラフィン類もしくはそれらの混合物を溶媒とし、少なくとも溶媒に不溶な色材を含有する構成を有し、 $10^7 \Omega \cdot \text{m}$ 以上の体積抵抗率を有する事を特徴とするインクジェットインクであり、溶媒中の芳香族類や不純物の含有量が非常に少なく、室温において適当な範囲の揮発性および粘度を有し、臭気が非常に小さいインクジェットインクの作製を可能とすると共に、高濃度でにじみの少ない記録画像の形成を可能にするという作用を有する。

【0015】本発明の請求項5に記載の発明は、請求項1～4いずれか1記載のインクジェットインクを記録電極が配置された記録ヘッドに導入し、記録電極と記録電極に対向して配置された対向電極との間に電圧を印加し前記インクに静電力を作用させることで、記録ヘッドより前記インクを飛翔させ記録電極と対向電極との間に配置された記録媒体上に印字ドットを形成し記録を行う事の特徴とする静電型インクジェット記録方法であり、室温において適当な範囲の揮発性および粘度を有しているので、インクの吐出が安定であると共に、インク吐出の応答周波数の低下を抑制することが可能であり、インクの臭気も非常に小さいものであり、高濃度でにじみの少ない記録画像の形成を可能にするという作用を有する。

【0016】本発明の請求項6に記載の発明は、少なくとも記録電極が配置された記録ヘッドと、記録電極に対向して配置された対向電極とを有し、請求項1～4いずれか1記載のインクジェットインクを記録電極が配置された記録ヘッドに導入し、記録電極と記録電極に対向して配置された対向電極との間に電圧を印加しインクに静電力を作用させることで、記録ヘッドよりインクを飛翔させ記録電極と対向電極との間に配置された記録媒体上に印字ドットを形成し記録を行う事の特徴とする静電型インクジェット記録装置であり、室温において適当な範囲の揮発性および粘度を有しているので、インクの吐出が安定であると共に、インク吐出の応答周波数の低下を抑制することが可能であり、インクの臭気も非常に小さいものであり、高濃度でにじみの少ない記録画像の形成を可能にするという作用を有する。

【0017】以下、本発明の実施の形態について説明する。

【0018】本発明のインクジェットインクは、前述のように、電気絶縁性の非水溶媒中に、少なくとも前記非水溶媒に不溶な色材を含有する構成を有し、前記溶媒がアニリン点77～92℃の炭化水素系溶剤である事の特徴とするものである。まず、本発明の特徴である溶媒について詳細に解説する。

【0019】先に述べたような色材凝集型の静電インクジェット記録装置においては、インクに $10^6 \Omega \cdot m$ 以上、好ましくは $10^7 \Omega \cdot m$ 以上といった高い体積抵抗率が要求されるため、使用する溶媒は $10^8 \Omega \cdot m$ 以上程度の体積抵抗率を有している必要があること、また反応性が低く安定で安全性が高いことが必要であるといった要求から、極性の低い炭化水素系溶剤は好適であると考えられるが、本発明のインクは、アニリン点が77～92℃の炭化水素系溶剤を溶媒として用いる事を最大の特徴とするものである。

【0020】ここで、炭化水素系溶剤のアニリン点について解説する。アニリン点とは、炭化水素または炭化水素混合物が等容積のアニリンと互いに溶解し均一な溶液として存在しうる最低温度をいう。アニリン点は炭化水

素の種類および分子量と密接な関係があり、等しい分子量であれば、パラフィン類が最も高く、ナフテン類はそれより低く、芳香族類は最低の値を示す。また、同属列では分子量が大きくなるほど高い値となる。従って、例えば、ある一定の沸点範囲で精製したパラフィン類に混入しているナフテン類、芳香族類等の含有量が多くなるほどアニリン点は低くなるため、パラフィン類の精製度の指標として用いられる。また、炭化水素系の組成が等しければ、その分子量に依存するため、炭化水素系溶剤の蒸発速度（揮発性）および粘度と密接な関係がある。石油製品のアニリン点試験方法は、JIS K 2256に規定されている。

【0021】色材凝集型の静電インクジェット記録装置においては、先に述べたように、吐出電極先端部近傍におけるインクの高粘度化や色材粒子の固着等が発生し、インクの吐出が不安定になったり、インク吐出の応答周波数が低下するという問題があった。これは、開口部からの溶媒の揮発や吐出電極への色材粒子並びに不純物の付着が原因であると考えられる。分子量が高く揮発性の低い溶媒を使用すると開口部からの溶媒の揮発は抑制されるが、インクの高粘度化による流動性の低下や色材粒子の泳動速度低下により、同様にインクの吐出が不安定になったり、インク吐出の応答周波数が低下するという問題が生じる場合がある。アニリン点が77～92℃の炭化水素系溶剤を溶媒として用いる事で、これらの問題が改善され、吐出安定性が高く、応答周波数の高いインクを実現する事が出来る。これは、インク溶媒のアニリン点を77～92℃の範囲内とすることで、溶媒の揮発性、不純物含有量、粘度が好ましい範囲に調節されたためであると考えられる。更にこの事によって、インクの臭気は非常に少なくなるため、本発明のインクは一般の家庭やオフィス環境での使用に適する物である。アニリン点が77℃より低くなると、溶剤の揮発性、もしくは不純物の含有量が高くなりすぎるため好ましくなく、特にアニリン点が60℃未満程度の物は、芳香族類の含有量が高いため、臭気が強く、安定性および安全性の面からも好ましくない。また、アニリン点が92℃を越えると、溶剤の揮発性が小さくなりすぎると共に、粘度が高くなりすぎるため好ましくない。

【0022】また、アニリン点が77～92℃の範囲にある炭化水素系溶剤で、沸点範囲が150～260℃のものを用いると、高い吐出安定性と応答周波数を実現でき、特に優れた性能が得られる。沸点範囲が150℃より低くなると溶剤の揮発性が高くなりすぎ、色材固着等も生じやすくなるため、インク吐出が不安定になりやすく、また、沸点範囲が260℃より高くなると、溶剤の粘度が高いために吐出応答周波数が低下する傾向が生じる。一般に、石油系溶剤の沸点は、蒸留範囲すなわち初留点(℃)と乾点(℃)、もしくは終点(℃)で表され、本発明における沸点範囲の定義もこれと同義であ

る。

【0023】上記の様な性状を有する炭化水素系溶剤は、一般に脂肪族系溶剤であり、芳香族系溶剤は含まれず、より具体的には主に、ノルマルパラフィン類、イソパラフィン類、ナフテン類の何れかもしくはそれらの混合物であるが、ノルマルパラフィン類、イソパラフィン類はナフテン類と比較してより臭気が少ないため、ノルマルパラフィン類、イソパラフィン類極もしくは両者の混合物を用いると、臭気を端に少なくする事が出来る。ここでいう、ノルマルパラフィン類、イソパラフィン類もしくは両者の混合物とは、高度に精製された、ノルマルパラフィン類、イソパラフィン類もしくは両者の混合物を主成分とする溶剤を意味するが、一般には非常に高度に精製されたこれらの溶剤にも、ppmレベルから最大0.5%以下程度の微量のナフテン類、芳香族類が混入している。しかしながら、これら微量の成分が臭気に与える影響は非常に小さくほぼ無視できる。従って、ここでいうノルマルパラフィン類、イソパラフィン類もしくは両者の混合物とは、上記のような微量不純物レベル以上の量のナフテン類および芳香族類を含まないものを意味する。

【0024】本発明のインクジェットインクにおける炭化水素系溶剤を用いた溶媒は、前記のような要求を満たす物であれば良く、特に限定される物ではないが、アニリン点が77～92℃の範囲内にある市販の炭化水素系溶剤の例としては、エクソン化学製のイソパラフィン系溶剤であるアイソパーG、H、L、M（商品名）、エクソン化学製のイソパラフィン系溶剤であるノーパー12、13、15（商品名）、エクソン化学製のパラフィン／ナフテン混合系溶剤であるエクソールD110、D130（商品名）、出光石油化学製のイソパラフィン系溶剤であるIPソルベント1620、2028（商品名）、日本石油化学製のノルマルパラフィン系溶剤であるノルマルパラフィンSL、L、M、H（商品名）、日本石油化学製のイソパラフィン系溶剤であるアイソゾール300、400（商品名）、丸善石油化学製のイソパラフィン系溶剤であるマルカゾールR（商品名）、シェルジャパン製のイソパラフィン系溶剤であるシェルゾール70、シェルゾール71、シェルゾール72（商品名）、シェルジャパン製のパラフィン／ナフテン混合系溶剤であるシェルゾールD100（商品名）がある。これらの炭化水素系溶剤製品は、少なくとも $10^{10} \Omega \cdot m$ 以上の高い体積抵抗率を有している。さらに、反応性が低く安定であり、低毒性で安全性が高く、臭気も少ないという特徴がある。このうち、沸点範囲が150～260℃の範囲にあるものは、アイソパーG、H、L、M（商品名）、ノーパー12、13（商品名）、IPソルベント1620（商品名）、ノルマルパラフィンSL、L、M、アイソゾール300、400（商品名）、マルカゾールR（商品名）、シェルゾール70、シェルゾー

ル71、シェルゾール72であり、また、ノルマルパラフィン類、イソパラフィン類もしくはそれらの混合物であるものは、アイソパーG、H、L、M（商品名）、ノーパー12、13、15（商品名）、IPソルベント1620、2028（商品名）、ノルマルパラフィンSL、L、M、H（商品名）、アイソゾール300、400（商品名）、マルカゾールR（商品名）、シェルゾール70、シェルゾール71、シェルゾール72である。さらに、アニリン点77～92℃、沸点範囲150～260℃の、ノルマルパラフィン類、イソパラフィン類もしくはそれらの混合物に該当する物としては、アイソパーG、H、L、M（商品名）、ノーパー12、13（商品名）、IPソルベント1620（商品名）、ノルマルパラフィンSL、L、M（商品名）、アイソゾール300、400（商品名）、マルカゾールR（商品名）、シェルゾール70、シェルゾール71、シェルゾール72があり、これらの製品を用いると、先述の様な理由から特に優れた性能が得られる。

【0025】本発明のインクにおける溶媒の性状は上記のような物であるが、インク化に際し、前記のようなインク物性の要求特性を満たす範囲で、少量の、例えばアルコール類等の炭化水素系溶剤以外の溶剤、また炭化水素系溶剤に可溶性の物質を添加する事は当然可能である。

【0026】続いて、本発明に関わるインクジェットインクを構成するその他の材料について説明する。

【0027】本発明のインクジェットインクにおける、溶媒に不溶な色材としては、顔料、もしくは顔料を溶媒に不溶性の樹脂等に分散させたもの、もしくは顔料表面に樹脂をグラフト化したもの等を用いる事が出来る。顔料としては、種々の無機および有機顔料を用いることが出来、例えば、カーボンブラック、β-ナフトール系アゾ顔料、ピラズロン系アゾ顔料、アセト酢酸アリリド系アゾ顔料、縮合アゾ顔料、ジスアゾ顔料、アントラピリジン顔料、インダンスレン顔料、フタロシアニン系顔料、キナクリドン顔料、インジゴ顔料、イソインドリノン顔料、ジオキサジン顔料、ペリレン顔料、フタロペリノン顔料、キノフタロン顔料、二酸化チタン等がある。また、溶媒に不溶性の樹脂としては、種々公知の天然もしくは合成樹脂を用いることが出来るが、例えばアクリル樹脂、エポキシ樹脂、エチレン-酢酸ビニル樹脂、塩化ビニル-酢酸ビニル樹脂、スチレン-ブタジエン樹脂等がある。これらの樹脂に顔料を分散させる手法としては、電子写真用トナーの製造プロセスに見られるような、種々公知の方法を用いれば良い。その他、ロジンエステル樹脂や塩化ビニル-酢酸ビニル樹脂等に顔料微粒子を分散させた加工顔料が市販されており、これを用いても良い。本発明のインクにおける、色材の濃度は、インクの総量に対して0.5～15重量%、特に好ましくは2～10重量%の範囲であることが好ましい。色材の

濃度が0.5重量%より少なくなると、十分な印字濃度が得られず好ましくない。また、15重量%より多くなると、インクの粘度が著しく増大し、安定なインク吐出が行えなくなる傾向が生じ好ましくない。

【0028】上記の様な色材を溶媒中に微粒子分散させると共に分散安定性を向上させる事、すなわち分散剤としての機能、並びに、紙等の記録媒体への色材の定着性を向上させる事、すなわち定着用バインダーとしての機能を主たる目的として、溶媒に可溶もしくは部分的に可溶な樹脂を加える事ができる。このような樹脂は、好ましくは、分散剤としての効果を考慮すれば、色材との親和性が高い物が良く、また、バインダーとしての効果を考慮すれば樹脂単体では室温で固体であるか、もしくは非常に高粘度の液体である物が好ましい。このような要求を満たす物であれば、樹脂の種類は特に限定される物ではないが、例えば炭化水素系の樹脂、アルキド樹脂、アクリル系樹脂等が好適な物として挙げられる。本発明のインクにおける樹脂の濃度は、インクの総量に対して、0.1~20重量%、特に好ましくは1~15重量%の範囲である事が好ましい。樹脂の濃度が0.1重量%より少なくなると、色材の分散性を向上させる効果、または記録媒体への色材の定着性を向上させる効果がほとんどなく、20重量%より多いとインクの粘度が増大し安定なインク吐出が行えなくなる傾向が生じ何れも好ましくない。

【0029】さらに、本発明におけるインクジェットインクには、色材を任意の極性および電荷量に帯電させるために、帯電制御剤を加える事が好ましい。帯電制御剤としては、ナフテン酸、オクチル酸、ステアリン酸等を脂肪酸成分とする金属石鹸、アルキル硫酸の金属塩、アルキルリン酸の金属塩、脂肪酸、レシチン等を用いることが出来、また、前記のような溶媒に可溶性の樹脂も帯電制御剤として機能する場合がある。色材を正極性に帯電させる場合には金属石鹸が特に好ましく、特に、カウリプタノール値の非常に低い(30未満)高純度の脂肪酸炭化水素溶剤に対しても高い溶解性を有していること、および顔料を帯電させる効果が高いことから、ナフテン酸およびオクチル酸を脂肪酸成分とする金属石鹸が特に好ましい。これら金属石鹸の金属原子としては、マンガ、鉛、亜鉛、カルシウム、アルミニウム、ジルコニウム、銅、鉄等が使用可能である。好ましい金属石鹸の具体例としては、ナフテン酸マンガ、ナフテン酸鉄、ナフテン酸ニッケル、ナフテン酸ジルコニウム、オクチル酸マンガ、オクチル酸鉄、オクチル酸ニッケル、オクチル酸ジルコニウム等がある。顔料および樹脂の構造や表面処理の影響により、特に帯電制御剤を加えなくても、色材が帯電する場合もあるが、このような帯電制御剤を用いると、より確実かつ効果的に色材を帯電させる事が可能となると共に、その添加量により色材の帯電量やゼータ電位およびインクの体積抵抗率を調整する事が

可能となる。本発明における帯電制御剤の濃度は、インクの総量に対して0.001~2.0重量%の範囲であることが好ましい。金属石鹸の濃度が0.001重量%より少ないと、色材に十分な帯電量を付与する効果が小さく、2.0重量%より多いとインクの体積抵抗率低下のため、印字濃度が低下する傾向が生じるため、何れも好ましくない。

【0030】本発明における基本的な構成材料は以上のような物であるが、このほかに分散剤、界面活性剤、ワックス、染料等の添加剤を適宜加えても良い。ただし、このとき、インクの体積抵抗率が $10^6 \Omega \cdot m$ 、好ましくは $10^7 \Omega \cdot m$ より低くならないように注意する必要がある。

【0031】次に、インクの作成方法について説明する。インクの作製は、種々の一般的な顔料系インク、トナー等の作製プロセスと同様に行うことができ、例えば、樹脂、金属石鹸、分散剤その他の補助添加剤を適当な粘度範囲になるように溶媒に混合溶解した物に顔料を加え、ビーズミル、アトライター、ボールミル、ペイントシェイカー等の分散機を用いて、数時間から数十時間程度混合粉碎する事により、数百nm~数μm程度の色材が分散されたインクの濃縮液を作製した後、使用する際の所定濃度まで分散倍で希釈しインクを作製する方法がある。

【0032】上記の様な材料および作製方法により、アニリン点77~92℃の炭化水素系溶剤を溶媒として用いたインクを作製することによって、吐出安定性が高く、高い応答周波数を有し、臭気の非常に少ない静電型インクジェット記録装置用インクを作製することができる。

【0033】

【実施例】次に、本発明を具体例により説明する。

【0034】(実施例1)丸善石油化学製の高純度イソパラフィン系溶剤であるマルカゾールR(商品名)、63.7gに、p-メチルスチレン/イソブチルメタクリレート/2-エチルヘキシルアクリレート共重合体(モル比で55/35/10、以下樹脂aと記す)7.50gとオクチル酸ジルコニウム0.060gを加え、樹脂aとオクチル酸ジルコニウムが完全に溶解するまで室温で混合攪拌した。ここで、マルカゾールRは、メーカー発行の資料によると、イソパラフィン100%(ガスクロマトグラフィーによる試験)であり、アニリン点は87.8℃、沸点範囲は178.5~181℃である。この混合溶液に、BASF社製のフタロシアニンブルー顔料であるヘリオゲンブルーD7072DD、3.75gを加えた後、直径1mmのジルコニア製ビーズと共にメノウ製の粉碎容器に入れ、ペイントシェイカーを用いて4時間混合粉碎し、顔料濃度5.0%のシアン顔料分散液を作製した。この顔料分散液をマルカゾールR(商品名)で希釈し、下記のような組成のインクAを作製し

た。

マルカゾールR
ヘリオゲン・ブルーD7072DD
樹脂 a
オクチル酸ジルコニウム

インクAは $107\Omega\cdot\text{m}$ 以上の体積抵抗率を有していた。ここで、体積抵抗率の測定には、キースレー6517型高抵抗系（商品名）および東洋真空工業1型液体電気抵抗測定用電極（商品名）を用い 25°C の恒温槽中で行った。また、大塚電子ELS-6000型ゼータ電位計（商品名）を用いて、顔料のゼータ電位を測定したところ、プラス 120mV と十分に高い値を有していた。ここでゼータ電位の測定に際しては、インクを溶媒（本実施例ではマルカゾールR）で約1000倍に希釈し、 25°C に保持した低誘電率用測定セルに導入し行った。また、インクの臭気に関し、良好な健康状態を有する成人男女30名による官能試験を行い、4：ほとんど無臭（特に良好）、3：低臭（良好）、2：有臭（不良）、1：きつい有臭（不良）の4段階で評価を行った結果、30人の平均値を四捨五入すると、4：ほとんど無臭と判定された。これらの物性値の測定条件および臭気の評価条件は以下の実施例および比較例についても同様である。

【0036】このインクAを次のような静電型インクジェットヘッドを用いて吐出、印字評価した。

【0037】ここで、図1は、本実施例におけるインクの評価に用いた静電型インクジェットヘッドの構成を示す斜視図である。

【0038】図1において、1はインクジェットヘッド、2はインクに記録信号となる電圧パルスを与えてインク液滴を吐出させるための金属製の記録電極、3は複数の記録電極2が形成された電極基板、4はプラスチック製のヘッドブロック上板、5は同じくプラスチック製のヘッドブロック下板、6はヘッドブロック上板4とヘッドブロック下板5によって形成され、インクタンク（図示せず）とインク流路（図示せず）で連結されたインク充填部、7はヘッドブロック上板4端部とヘッドブロック下板5端部によって形成されたスリット状の開口部、8はインク中の色材を効率的に記録電極先端部近傍に泳動させるための泳動電極、9は記録電極2に対向して配置された金属製の対向電極、10は対向電極に密着

【0035】

92.5重量%
2.5重量%
5.0重量%
0.04重量%

する形で、インクジェットヘッド1の長手方向と垂直に移動可能に配置された記録紙である。インク流路（図示せず）から供給されたインク（図示せず）はインク充填部6に充填され、開口部7においてインクブロック上板4と電極基板3および記録電極2先端との間でメニスカスを形成する。本実施例においては、ヘッドブロック上板4端部と電極基板3との間の間隔すなわちスリット幅は約 $150\mu\text{m}$ 、記録電極2の幅は約 $60\mu\text{m}$ 、記録電極2の配列間隔は約 $85\mu\text{m}$ 、記録電極2先端と記録紙との間隔は 0.7mm とした物を用いた。このような構成のインクジェットヘッドにおいて、プラス帯電性の色材を分散させたインクを用いる場合には、対向電極9には常に一定のマイナス電圧を印加し、さらに泳動電極8に一定のプラス電圧を印加しながら、記録紙10をインクジェットヘッド1の長手方向と垂直に移動させながら、記録電極2に記録信号となるプラスの電圧パルスを一定の周波数で印加することで、記録電極2の先端より対向電極9に向かって静電引力によりインク滴を吐出させ、記録紙状に一定の周期のドットを形成する。

【0039】このインクジェットヘッドを用いて、インクAについて、対向電極電圧 -1.2kV 、記録電極電圧 $+400\text{V}$ 、泳動電極電圧 $+200\text{V}$ の条件でコピー用紙に連続してドット印字を行い、吐出の安定性、記録周波数への応答性と印字濃度（光学濃度）を評価した。反射濃度の測定には、グレッグ濃度計D19Cを用いた。この結果、光学濃度1.4以上という、市販のインクジェットプリンター同等以上の印字濃度で、滲みの少ない均一なドットが 2kHz の記録周波数でドット抜けなく安定に記録する事が可能であった。また、5万ドットの印字を、インクジェットヘッドを解放した状態での10分間の休止を挟んで10回繰り返した後のインクジェットヘッドにつき、記録電極先端部近傍の様子を光学顕微鏡により観察したところ、色材の固着はほとんど見られなかった。

【0040】

【表1】

	インク名	溶媒				印字評価	臭気
		商品名	組成分類	アニリン点 (°C)	沸点範囲 (°C)		
実施例 1	A	マルカゾールR	イソパラフィン	88	179 ~ 181	◎	4
実施例 2	B	シェルゾール70	イソパラフィン	77	156 ~ 183	◎	4
実施例 3	C	IPソルベント1620	イソパラフィン	81	166 ~ 202	◎	4
実施例 4	D	シェルゾール72	イソパラフィン	85	215 ~ 248	◎	4
実施例 5	E	日石アイソゾール400	イソパラフィン	87	210 ~ 254	◎	4
実施例 6	F	アイソパーM	イソパラフィン	90	218 ~ 253	◎	4
実施例 7	G	NORPAR 12	ノルマルパラフィン	82	188 ~ 217	◎	4
実施例 8	H	NORPAR 13	ノルマルパラフィン	87	226 ~ 242	◎	4
実施例 9	I	NORPAR 15	ノルマルパラフィン	92	252 ~ 272	○	4
実施例 10	J	エクソールD110	パラフィン/ナフテン混合	82	243 ~ 272	○	3
実施例 11	K	エクソールD130	パラフィン/ナフテン混合	90	277 ~ 310	○	3
比較例 1	L	IPソルベント1016	イソパラフィン	72	73 ~ 140	×	3
比較例 2	M	アイソパーV	イソパラフィン	98	274 ~ 314	×	4
比較例 3	N	IPソルベント2835	イソパラフィン	104	277 ~ 353	×	4
比較例 4	O	エクソールD30	パラフィン/ナフテン混合	64	141 ~ 164	×	2

【0041】(表1)は、実施例1および以降に示す実施例2～11と比較例1～4における溶媒の物性値および印字と臭気の評価結果の一覧である。

【0042】ここで、印字評価の項は、光学濃度1.4以上のドットが、ドット抜けの発生確率が市販のインクジェットプリンターと同様の0.05%未満で印字できる記録周波数が、2kHz以上であった場合は◎(特に良好)、1kHz以上2kHz未満であった場合は○(良好)、1kHz以下もしくは安定印字が行えなかった場合は×(不良)とした。臭気の項は、前述の官能評価における4段階評価の結果を示し、3以上の場合は良好であると判断できる。上記印字評価、臭気、色材固着状態の評価条件は、以下の実施例2～11及び比較例1～4についても同様である。

【0043】(実施例2～6)実施例1のインクAにおけるマルカゾールRの代わりに、シェルジャパン製のシェルゾール70(商品名)、出光石油化学製のIPソルベント1620(商品名)、シェルジャパン製のシェルゾール72(商品名)、日本石油化学製のアイソゾール400(商品名)、エクソン化学製のアイソパーM(商品名)をそれぞれ溶媒として用い、実施例1と同様にインクB、C、D、E、Fを作製した。これらの溶媒は何れもイソパラフィン100%である。

【0044】インクB～Fは、何れもインクAと同様に、 $10^7 \Omega \cdot m$ 以上の体積抵抗率と高いゼータ電位を有していた。

【0045】インクB～Fにつき、それぞれの溶媒のアニリン点と沸点範囲、および実施例1と同様の印字評価、臭気の評価を行った結果を(表1)に記載した。このように、何れのインクもインクAと同様に良好な特性を有していた。また、何れのインクを用いた場合も、印字評価後のインクジェットヘッドの記録電極先端部における色材固着はほとんど見られなかった。

【0046】(実施例7～9)エクソン化学製のノルマルパラフィン100%の溶剤であるノーパー12、13、15(商品名)をそれぞれ溶媒として用い、実施例

1と同様にしてインクG、H、Iを作製した。これらのインクは、何れもインクAと同様に、 $10^7 \Omega \cdot m$ 以上の体積抵抗率と高いゼータ電位を有していた。

【0047】インクG～Iにつき、それぞれの溶媒のアニリン点と沸点範囲、および実施例1と同様の印字評価、臭気の評価を行った結果を(表1)に記載した。このように、何れのインクも良好な特性を示した。ただし、インクIは吐出周波数が2kHz未満と、上記その他の実施例に比べ低く、この原因として、沸点範囲が高い溶媒を用いた事によるインクの粘度上昇が考えられる。また、何れのインクを用いた場合も、印字評価後のインクジェットヘッドの記録電極先端部における色材固着はほとんど見られなかった。

【0048】(実施例10、11)実施例1のインクAにおけるマルカゾールRの代わりに、エクソン化学製のパラフィン/ナフテン混合溶剤であるエクソールD110、D130(商品名)をそれぞれ溶媒として用い、実施例1と同様にしてインクJ、Kを作製した。これらのインクは、何れもインクAと同様に、 $10^7 \Omega \cdot m$ 以上の体積抵抗率と高いゼータ電位を有していた。インクJ、Kにつき、それぞれの溶媒のアニリン点と沸点範囲、および実施例1と同様の印字評価、臭気の評価を行った結果を(表1)に記載した。このように、何れのインクも良好な特性を有していたが、実施例1と比較すると、応答周波数が低かった。これは、インクIの場合と同様に、沸点範囲が高い溶媒を用いた事によるインクの粘度上昇によるものと考えられる。臭気に関しては、イソパラフィン溶剤もしくはノルマルパラフィン溶剤を用いたインクA～Iと比較すると、やや臭気が強く、これは、溶媒中に多量のナフテン分が存在しているためであると考えられる。また、何れのインクを用いた場合も、印字評価後のインクジェットヘッドの記録電極先端部に付着物はほとんど確認されなかった。

【0049】(比較例1)実施例1のインクAにおけるマルカゾールRの代わりに、出光石油化学製のイソパラフィン100%の溶剤であるIPソルベント1620

(商品名)を溶媒として用い、実施例1と同様にしてインクLを作製した。

【0050】インクLは、何れもインクAと同様に、 $10^7\Omega \cdot m$ 以上の体積抵抗率と高いゼータ電位を有していた。

【0051】インクLにつき、溶媒のアニリン点と沸点範囲、および実施例1と同様の印字評価、臭気の評価を行った結果を(表1)に記載した。このように、インクLでは良好な印字結果が得られず、さらに、印字評価後のインクジェットヘッドの記録電極先端部には、固着物が確認された。また、 150°C 以上の沸点範囲を有するイソパラフィン系もしくはノルマルパラフィン系溶剤を用いたインクA~Iと比較すると、やや臭気が強く感じられた。

【0052】(比較例2, 3)実施例1のインクAにおけるマルカゾールRの代わりに、エクソン化学製のイソパラフィン100%溶剤であるアイソパーV(商品名)、出光石油化学製のイソパラフィン100%の溶剤であるIPソルベント2835(商品名)をそれぞれ溶媒として用い、実施例1と同様にしてインクM, Nを作製した。

【0053】インクM, Nは、何れもインクAと同様に、 $10^7\Omega \cdot m$ 以上の体積抵抗率と高いゼータ電位を有していた。

【0054】インクM, Nにつき、それぞれの溶媒のアニリン点と沸点範囲、および実施例1と同様の印字評価、臭気の評価を行った結果を(表1)に記載した。このように、何れのインクも臭気に関しては良好であったが、良好な印字結果が得られなかった。これは、溶媒のアニリン点および沸点範囲が高すぎる事により、インクの粘度が高くなりすぎたであると考えられる。何れのインクを用いた場合も、印字評価後のインクジェットヘッドの記録電極先端部における色材固着はほとんど見られなかった。

【0055】(比較例4)実施例1のインクAにおけるマルカゾールRの代わりに、エクソン化学製のパラフィン/ナフテン混合溶剤であるエクソールD30(商品名)を溶媒として用い、実施例1と同様にしてインクOを作製した。インクOは、何れもインクAと同様に、 $10^7\Omega \cdot m$ 以上の体積抵抗率と高いゼータ電位を有して

いた。

【0056】インクOにつき、溶媒のアニリン点と沸点範囲、および実施例1と同様の印字評価、臭気の評価を行った結果を(表1)に記載した。このように、インクOでは良好な印字結果が得られず、さらに、印字評価後のインクジェットヘッドの記録電極先端部には、固着物が確認された。また、臭気に関しても良好な結果が得られなかった。

【0057】以上の実施例および比較例で示したように、アニリン点が $77\sim 92^\circ\text{C}$ の炭化水素系溶剤を溶媒として用いたインクでは、臭気が少なく、安定に応答周波数の高い印字を実現することが出来る。また、沸点範囲が $150\sim 260^\circ\text{C}$ でアニリン点が $77\sim 92^\circ\text{C}$ の炭化水素系溶剤を用いると特に応答周波数の高い印字を実現することが出来る。さらに、このような炭化水素系溶剤として、ノルマルパラフィン類もしくはイソパラフィン類を用いると、インクの臭気を非常に少なくすることが出来る。またこの場合、ノルマルパラフィン類とイソパラフィン類の混合物でも同様であることは説明を要しない。

【0058】

【発明の効果】以上のように本発明によれば、優れた印字性能を有し、さらに一般の家庭やオフィス環境での使用に適したインクジェットインク、それを用いた静電型インクジェット記録方法及び装置を実現する事が出来る。

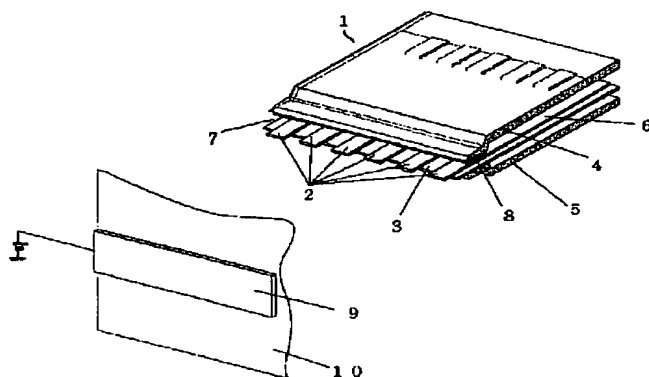
【図面の簡単な説明】

【図1】本実施例におけるインクの評価に用いた静電型インクジェットヘッドの構成を示す斜視図

【符号の説明】

- 1 インクジェットヘッド
- 2 記録電極
- 3 電極基板
- 4 ヘッドブロック上板
- 5 ヘッドブロック下板
- 6 インク充填部
- 7 開口部
- 8 泳動電極
- 9 対向電極
- 10 記録紙

【図 1】



フロントページの続き

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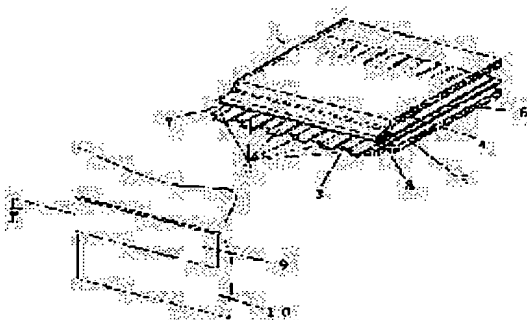
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(54) INK JET INK, METHOD FOR ELECTROSTATIC INK JET RECORDING USING THE INK AND DEVICE FOR THE RECORDING

(57)Abstract:

PROBLEM TO BE SOLVED: To produce an ink jet ink which has an excellent printing performance and is suitable for employment in ordinary homes and office environments, to provide a method for electrostatic ink jet recording using the ink, and to provide a device for the electrostatic ink jet recording.

SOLUTION: This ink jet ink comprising an electrically insulating non-aqueous solvent and a coloring material at least insoluble in the non-aqueous solvent and having a volume resistivity of $\geq 10^6 \Omega \cdot m$ is characterized in that the solvent is a hydrocarbon-based solvent having an aniline point of 77 to 92°C.k.



CLAIMS

[Claim(s)]

[Claim 1] Ink jet ink characterized by being ink jet ink which has a configuration containing a color material insoluble to said non-aqueous solvent at least, and has the volume resistivity of 106 or more ohm-m in the non-aqueous solvent of electric insulation, and said solvent being the hydrocarbon system solvent of 77-92

degrees C of aniline points.

[Claim 2] Ink jet ink according to claim 1 in which the boiling range of said hydrocarbon system solvent is characterized by being 150-260 degrees C.

[Claim 3] Claim 1, ink jet ink given [any 1] in two which are characterized by said hydrocarbon system solvents being normal paraffin, isoparaffins, or those mixture.

[Claim 4] Ink jet ink which uses normal paraffin of 77-92 degrees C of aniline points, and 150-260 degrees C of boiling ranges, isoparaffins, or those mixture as a solvent, and is characterized by having the configuration which contains an insoluble color material in said solvent at least, and having the volume resistivity of 10⁷ or more ohm-m.

[Claim 5] By introducing ink jet ink claim 1 - given [any 1] in four into the recording head by which the record electrode has been arranged, impressing an electrical potential difference between the counterelectrodes which countered said record electrode and said record electrode, and have been arranged, and making electrostatic force act on said ink The electrostatic type ink jet record approach characterized by recording by forming a printing dot on the record medium which said ink was made to fly and has been arranged between said record electrodes and said counterelectrodes from said recording head.

[Claim 6] It has the recording head by which the record electrode has been arranged at least, and the counterelectrode which countered said record electrode and has been arranged. Ink jet ink claim 1 - given [any 1] in four is introduced into the recording head by which said record electrode has been arranged. By impressing an electrical potential difference between the counterelectrodes which countered said record electrode and said record electrode, and have been arranged, and making electrostatic force act on said ink The electrostatic type ink jet recording device characterized by recording by forming a printing dot on the record medium which said ink was made to fly and has been arranged between said record electrodes and said counterelectrodes from said recording head.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the electrostatic type ink jet record approach and recording device which used ink jet ink and it.

[0002]

[Description of the Prior Art] The ink jet recording method for printing by making ink fly to a record medium and forming a record dot is easy to colorize, and is attracting the interest in the regular paper as a non impact recording method which can carry out direct record, and the printer using this method is put in practical use variously. There is the ink jet recording method of an electrostatic type impress an electrical potential difference to two or more record electrodes which countered the record medium and have been arranged as one of the ink jet recording methods, and the counterelectrode arranged at the tooth back of a record medium, make electrostatic force act on the ink supplied on the record electrode, and make ink fly on a record medium according to the potential difference produced between two electrodes. These electrostatic ink jet printers are introduced to a "ink jet record technique" and Triceps Issuance (1989).

[0003] an example of the full color recording head of the drop mold on demand constituted by such electrostatic ink jet method – JP,58-215253,A, an institute-of-telecommunications-engineers paper magazine, Vol.J68-C, and 2 (1985) – it is indicated and announced by the 100th page from the 93rd page. [for example,] This method uses for the wall the ink delivery of the shape of a long and slender slit which has many record electrodes instead of the nozzle in the conventional ink jet head. For this reason, it is an effective approach also in order to realize the so-called long line head of the die length which can expect reduction of a

manufacturing cost according to there being few fears of receiving the blinding of ink, and the configuration of a head being simple, and can cover the large area of the cross direction of a record medium. In this electrostatic type ink jet head Although the oily ink which dissolved the color in the organic solvent is used suitably and indicated by the detail about the component of ink In the example seen in an institute-of-telecommunications-engineers paper magazine, Vol.J68-C, 2, pp.93-100, and (1985), the ink in which 105 - 106 ohm-m and surface tension have 22 mN/m, and viscosity has [a volume resistivity (electrical resistivity)] the physical-properties value of 3.1-6.9cP is used. However, since surface tension was low as compared with the water color ink generally used in other Inn Jet methods, such oily ink had the dramatically large permeability to the recording paper, and when printing especially in a regular paper, it had the problem of being easy to produce lowering of printing concentration, a blot, and flesh-side projection.

[0004] On the other hand, JP,9-11475,A, JP,9-118015,A, and JP,9-193389,A are made to concentrate a color-material particle on the discharge part at the head of a discharge electrode by electrophoresis, and the electrostatic ink jet head which makes an ink droplet fly in the form where color material was condensed at high concentration is indicated by the electrostatic field by which the electrified color-material particle (toner) was formed between the discharge electrode and the counterelectrode using the ink distributed in the high liquid of electric insulation at them, for example. In this case, the potential of the electrification polarity of color material and like-pole nature is given to a discharge electrode, and the potential of the electrification polarity and reversed polarity of color material is usually given to a counterelectrode. By this method, although the detail of that regurgitation principle is not clarified, an above-mentioned trouble is solved by unlike the above-mentioned method, not being breathed out while the constituent of ink had contained a lot of liquid components in the uniform condition, but color material's condensing, and breathing out ink in the condition with few liquid components. Moreover, compared with the ink jet head using the conventional color, an advantageous result is obtained also about the water resisting property of a printing image, and lightfastness by using a pigment as a color material.

[0005] In the electrostatic ink jet ink of such a color-material condensation mold, printing concentration is high, and in order to acquire the good printing property which produces neither a blot nor flesh-side projection, it is required 1st for the volume resistivity of ink to be large enough first. It becomes possible to make the electric field which were formed with the record electrode and the counterelectrode of this thing, and were impressed to ink reach a color-material particle. Moreover, if the volume resistivity of ink is low, with the electrical potential difference impressed with a record electrode, ink will receive charge impregnation, and will be charged, and the inclination breathed out while ink had contained a lot of liquid components according to electrostatic repulsion will become strong. Next, in order to centralize a color-material particle on the delivery section by electrophoresis at sufficient rate, it is required to have amount of electrifications with a sufficient color-material particle, i.e., for the color-material particle to have the high F-potential of straight polarity or negative polarity. Moreover, it is supposed from the balance of discharging performance and sedimentation prevention of a color-material particle that the mean particle diameter of a color-material particle is desirable about 0.1-4 micrometers.

[0006] Specifically, the activity of the ink in which electrical resistivity was adjusted more than 106ohm and m into the dielectric liquid of 108 or more ohm-m by distributing the developer particle (hard resin particle which has a coloring matter component at least) in within the limits whose F-potential to said dielectric liquid is 60mV or more and, whose mean particle diameter is 5 micrometers of 0.01 **** so that it might have the electrical resistivity of 108 or more ohm-m most preferably is indicated by JP,9-193389,A. Such ink as the hydrocarbon system solvent which has the volume resistivity of 108 or more ohm-m as for example, an insulating liquid, and a color material Although it is thought possible to prepare by producing a color-material dispersing element by the system which added the dispersant, the electrification control agent, etc. to the inside of the binder which becomes a carbon black pigment and an organic pigment, and a list from resin or a wax, or a front face, using the thing containing a pigment The detail of a suitable presentation and suitable ingredient of ink, the production approach, and an ink physical-properties value is not indicated.

[0007]

[Problem(s) to be Solved by the Invention] In the electrostatic ink jet recording method of the above color-material condensation molds Using the ink of a configuration of having distributed the color-material particle in the non-aqueous solvent to the discharge part at the head of a discharge electrode established in the substrate up which forms slit-like opening The configuration which makes an ink droplet fly in the form where centralized the color-material particle in ink by electrophoresis, and color material was condensed by high concentration sake, In volatilization of the non-aqueous-solvent solvent from opening, and the color-material particle list to a discharge electrode, by adhesion of an impurity etc. Hyperviscosity-izing of ink, fixing (sticking) of a color-material particle, etc. occurred, and there was a problem that the regurgitation of ink became instability or the response frequency of the ink regurgitation fell. [/ near the discharge electrode point] Moreover, although volatilization of the solvent from opening was controlled when molecular weight used the volatile low high solvent, there was a problem that the regurgitation of ink became instability similarly or the response frequency of the ink regurgitation fell by the fluid lowering and the migration rate lowering of a color-material particle by hyperviscosity-izing of ink. Furthermore, in order to use a non-aqueous solvent, the odor occurred according to causes, such as a content of the molecular structure of a solvent, volatility, and an impurity, and there was a case where it became a problem on the occasion of the activity by a general home and office environment especially.

[0008] This invention is an object which solves the above-mentioned conventional trouble, has the outstanding printing engine performance and aims at offering the electrostatic type ink jet record approach and equipment using the ink jet ink suitable for the activity by still more general home and office environment, and it.

[0009]

[Means for Solving the Problem] The ink jet ink of this invention has the configuration which contains a color material insoluble to said non-aqueous solvent at least in the non-aqueous solvent of electric insulation, and considered it as the configuration said whose solvent is the hydrocarbon system solvent of 77-92 degrees C of aniline points.

[0010] According to this invention, it has the outstanding printing engine performance and the ink jet ink suitable for the activity by still more general home and office environment can be realized.

[0011]

[Embodiment of the Invention] Invention of this invention according to claim 1 has the configuration which contains a color material insoluble to a non-aqueous solvent at least in the non-aqueous solvent of electric insulation. It is ink jet ink which has the volume resistivity of 106 or more ohm-m. While lessening dramatically the content of the naphthenes in the hydrocarbon system solvent which is ink jet ink characterized by a solvent being the hydrocarbon system solvent of 77-92 degrees C of aniline points, and is a solvent, and aromatic series It has an operation of making into the suitable range molecular weight of the hydrocarbons which constitute a solvent.

[0012] In claim 1, invention of this invention according to claim 2 is ink jet ink in which the boiling range of a hydrocarbon system solvent is characterized by being 150-260 degrees C, and has an operation of making the volatility of an ink solvent and viscosity in a room temperature into the suitable range.

[0013] In claims 1 and 2, invention of this invention according to claim 3 is ink jet ink characterized by hydrocarbon system solvents being normal paraffin, isoparaffins, or those mixture, and has an operation that there is very small the odor of ink.

[0014] Invention of this invention according to claim 4 77-92 degrees C of aniline points, and 150-260 degrees C of boiling ranges, Normal paraffin, isoparaffins, or those mixture are used as a solvent. It is ink jet ink characterized by having a configuration containing a color material insoluble to a solvent at least, and having the volume resistivity of 107 or more ohm-m. While there are dramatically few contents of the aromatic series in a solvent and an impurity, it has the volatility of the suitable range, and viscosity in a room temperature and an odor enables production of very small ink jet ink, it has an operation of enabling formation of few record

images of a blot by high concentration.

[0015] Invention of this invention according to claim 5 introduces ink jet ink claim 1 - given [any 1] in four into the recording head by which the record electrode has been arranged. By impressing an electrical potential difference between the counterelectrodes which countered the record electrode and the record electrode and have been arranged, and making electrostatic force act on said ink It is the electrostatic type ink jet record approach characterized by recording by forming a printing dot on the record medium which said ink was made to fly and has been arranged between a record electrode and a counterelectrode from the recording head. Since it has the volatility of the suitable range, and viscosity in the room temperature, while the regurgitation of ink is stable It has an operation of it being possible to control lowering of the response frequency of the ink regurgitation, and the odor of ink being also very small, and enabling formation of few record images of a blot by high concentration.

[0016] The recording head by which, as for invention of this invention according to claim 6, the record electrode has been arranged at least, Have the counterelectrode which countered the record electrode and has been arranged and ink jet ink claim 1 - given [any 1] in four is introduced into the recording head by which the record electrode has been arranged. By impressing an electrical potential difference between the counterelectrodes which countered the record electrode and the record electrode and have been arranged, and making electrostatic force act on ink It is the electrostatic type ink jet recording device characterized by recording by forming a printing dot on the record medium which ink was made to fly and has been arranged between a record electrode and a counterelectrode from the recording head. Since it has the volatility of the suitable range, and viscosity in the room temperature, while the regurgitation of ink is stable It has an operation of it being possible to control lowering of the response frequency of the ink regurgitation, and the odor of ink being also very small, and enabling formation of few record images of a blot by high concentration.

[0017] Hereafter, the gestalt of operation of this invention is explained.

[0018] The ink jet ink of this invention has the configuration which contains a color material insoluble to said non-aqueous solvent at least in the non-aqueous solvent of electric insulation as mentioned above, and is characterized by said solvent being the hydrocarbon system solvent of 77-92 degrees C of aniline points. First, the solvent which is the description of this invention is explained to a detail.

[0019] In the electrostatic ink jet recording device of a color-material condensation mold which was described previously Since high volume resistivities, such as more than 107ohm and m, are preferably required of ink more than 106ohm and m, Although it is thought from demand that the solvent to be used needs that it is necessary to have the volume resistivity of 108 or more ohm-m extent and, and for reactivity to be low stable and for safety to be high that a polar low hydrocarbon system solvent is suitable It is characterized [greatest] by using for the ink of this invention as a solvent the hydrocarbon system solvent whose aniline point is 77-92 degrees C.

[0020] Here, the aniline point of a hydrocarbon system solvent is explained. The aniline point means the minimum temperature which a hydrocarbon or hydrocarbon mixture dissolves mutually with the aniline of an isochore product, and may exist as a uniform solution. The aniline point has the close relation to the class of hydrocarbon, and molecular weight, if it is equal molecular weight, paraffin is the highest, naphthenes are lower than it, and aromatic series shows the minimum value. Moreover, in a congeneric train, it becomes such a high value that molecular weight becomes large. Since the aniline point becomes low so that contents currently mixed in the paraffin which followed, for example, was refined in a certain fixed boiling range, such as naphthenes and aromatic series, increase, it is used as an index of whenever [purification / of paraffin]. Moreover, if the presentation of hydrocarbons is equal, in order to be dependent on the molecular weight, there is close relation to the vapor rate (volatility) of a hydrocarbon system solvent and viscosity. The aniline point test approach of a petroleum product is JIS. K It is specified to 2256.

[0021] In the electrostatic ink jet recording device of a color-material condensation mold, as stated previously, hyperviscosity-izing of ink, fixing of a color-material particle, etc. occurred, and there was a problem that the regurgitation of ink became instability or the response frequency of the ink regurgitation fell. [/ near the

discharge electrode point] This is considered that adhesion of an impurity is the cause by the color-material particle list to volatilization of the solvent from opening, or a discharge electrode. Although volatilization of the solvent from opening is controlled if molecular weight uses an volatile low high solvent, the problem that the regurgitation of ink becomes instability similarly or the response frequency of the ink regurgitation falls by the fluid lowering and the migration rate lowering of a color-material particle by hyperviscosity-izing of ink may arise. By using as a solvent the hydrocarbon system solvent whose aniline point is 77-92 degrees C, these problems are solved, regurgitation stability is high and ink with a high response frequency can be realized. This is making the aniline point of an ink solvent into within the limits of 77-92 degrees C, and is considered to be because for the volatility of a solvent, an impurity content, and viscosity to have been adjusted in the desirable range. Furthermore, since the odor of ink decreases dramatically by this thing, the ink of this invention is an object suitable for the activity by a general home and office environment. If the aniline point becomes lower than 77 degrees C, since the content of aromatic series is high, the object especially whose aniline point is less than 60-degree-C extent preferably since the volatility of a solvent or the content of an impurity becomes high too much has a strong odor, and it is not desirable from the field of stability and safety. Moreover, if the aniline point exceeds 92 degrees C, while the volatility of a solvent will become small too much, since viscosity becomes high too much, it is not desirable.

[0022] Moreover, if that whose boiling range is 150-260 degrees C is used with the hydrocarbon system solvent in the range whose aniline point is 77-92 degrees C, high regurgitation stability and a response frequency can be realized and the especially excellent engine performance will be obtained. Since the volatility of a solvent will become high too much and it will become easy to produce color-material fixing etc., if a boiling range becomes lower than 150 degrees C, if the ink regurgitation tends to become instability and a boiling range becomes higher than 260 degrees C, since the viscosity of a solvent is high, the inclination for a regurgitation response frequency to fall will arise. Generally, the boiling point of a petroleum solvent is expressed at a distillation range, i.e., the initial boiling point (degree C) and the dry point (degree C), or a terminal point (degree C), and its definition of the boiling range in this invention is also synonymous with this.

[0023] Generally the hydrocarbon system solvent which has the above descriptions is an aliphatic series system solvent, an aromatic solvent is not contained, but although it is either or those mixture of normal paraffin, isoparaffins, and naphthenes, since there are more few odors as compared with naphthenes, if normal paraffin and isoparaffins use the mixture of normal paraffin, an isoparaffin pole, or both, they can more specifically be used [odor] as an edge few mainly. Although the mixture of normal paraffin here, isoparaffins, or both means the solvent which uses as a principal component mixture of the normal paraffin refined by altitude, isoparaffins, or both, the naphthenes of the minute amount of extent and aromatic series are mixed also in these solvents generally dramatically refined by altitude a maximum of 0.5% or less from ppm level. However, the effect which the component of these minute amounts has on an odor can be disregarded mostly very small. Therefore, the mixture of normal paraffin here, isoparaffins, or both means what does not contain the naphthenes and aromatic series of an amount more than the above minute-impurities level.

[0024] The solvent using the hydrocarbon system solvent in the ink jet ink of this invention As an example of the hydrocarbon system solvent of marketing which is in within the limits whose aniline point is 77-92 degrees C that what is necessary is just the object which fills the above demands although it is not the object limited especially Isopar G, H, L, and M (trade name) which is an isoparaffin system solvent made from Exxon chemistry, The no pars 12, 13, and 15 (trade name) which are the isoparaffin system solvents made from Exxon chemistry, EKUSORU D110 and D130 (trade name) which is the paraffin / naphthene mixed stock solvent made from Exxon chemistry, The IP solvents 1620 and 2028 (trade name) which are the isoparaffin system solvents made from the Idemitsu petrochemistry, The normal paraffin SL, L, M, and H (trade name) which is a normal paraffin system solvent made from the Nippon Oil chemistry, Eye SOZORU 300,400 (trade name) which is an isoparaffin system solvent made from the Nippon Oil chemistry, Mull KAZORUR which is the Maruzen Petrochemical isoparaffin system solvent (trade name) There are shell ZORU 70 which is an isoparaffin system solvent made from shell JAPAN, shell ZORU 71, shell ZORU 72 (trade name), and shell

ZORU D100 (trade name) that is the paraffin / naphthene mixed stock solvent made from shell JAPAN. These hydrocarbon system solvent products have the high volume resistivity of at least 1010 or more ohm-m. Furthermore, reactivity is low stable, by low toxicity, safety is high and an odor also has the description of being few. Among these, the thing in the range whose boiling range is 150-260 degrees C Isopar G, H, L, and M (trade name), the no pars 12 and 13 (trade name), The IP solvent 1620 (trade name), normal paraffin SL, L, and M, Eye SOZORU 300,400 (trade name), mull KAZORUR (trade name) What is shell ZORU 70, shell ZORU 71, and shell ZORU 72, and is normal paraffin, isoparaffins, or those mixture Isopar G, H, L, and M (trade name), the no pars 12, 13, and 15 (trade name), They are the IP solvents 1620 and 2028 (trade name), normal paraffin SL, L, M, and H (trade name), eye SOZORU 300,400 (trade name), mull KAZORUR (trade name), shell ZORU 70, shell ZORU 71, and shell ZORU 72. furthermore, as an object applicable to normal paraffin of 77-92 degrees C of aniline points, and 150-260 degrees C of boiling ranges, isoparaffins, or those mixture Isopar G, H, L, and M (trade name), the no pars 12 and 13 (trade name), The IP solvent 1620 (trade name), normal paraffin SL, L, and M (trade name), If there are eye SOZORU 300,400 (trade name), mull KAZORUR (trade name), shell ZORU 70, shell ZORU 71, and shell ZORU 72 and these products are used, the engine performance which was excellent from especially a reason like point ** will be obtained.

[0025] Although the description of the solvent in the ink of this invention is the following, it is the range which fulfills the demand characteristics of the above ink physical properties on the occasion of ink-izing, and it is little, for example, naturally it is possible to add the matter of fusibility to the solvents and hydrocarbon system solvents other than hydrocarbon system solvents, such as alcohols.

[0026] Then, the ingredient of others which constitute the ink jet ink in connection with this invention is explained.

[0027] As a color material insoluble to a solvent in the ink jet ink of this invention, the thing which made insoluble resin etc. distribute a pigment or a pigment to a solvent, or the thing which graft-ized resin on the pigment front face can be used. As a pigment, inorganic [various] and an organic pigment can be used, for example, there are carbon black, a beta-naphthol system azo pigment, a pyrazolone system azo pigment, an acetoacetic-acid ARIRIDO system azo pigment, a disazo condensation pigment, a disazo pigment, an anthra pyridine pigment, an indanthrene pigment, phthalocyanine pigment, a quinacridone pigment, an indigo pigment, an isoindolinone pigment, a dioxazine pigment, a perylene pigment, a phtalo peri non pigment, a kino FUTARON pigment, a titanium dioxide, etc. Moreover, although well-known nature or synthetic resin can be variously used for a solvent as insoluble resin, there are acrylic resin, an epoxy resin, ethylene-vinyl acetate resin, vinyl chloride-vinyl acetate resin, styrene-butadiene resins, etc., for example. as [see / as the technique of making these resin distribute a pigment / the manufacture process of the toner for electrophotography] – what is necessary is just to use a well-known approach variously In addition, the processing pigment which made rosin ester resin, vinyl chloride-vinyl acetate resin, etc. distribute a pigment particle is marketed, and this may be used. As for the concentration of color material in the ink of this invention, it is desirable that it is 2 - 10% of the weight of the range especially preferably 0.5 to 15% of the weight to the total amount of ink. If the concentration of color material becomes less than 0.5 % of the weight, sufficient printing concentration is not obtained and it is not desirable. Moreover, if it increases more than 15 % of the weight, the inclination for the viscosity of ink to increase remarkably and for it to become impossible to perform the stable ink regurgitation generates and is not desirable.

[0028] While carrying out particle distribution of the above color material into a solvent, meltable resin can be added to a solvent meltable or selectively at raising distributed stability, i.e., the function as a dispersant, and a list by setting the function as raising fixable [of the color material to record media, such as paper,], i.e., a binder for fixation, as the main object. Preferably, if the effectiveness as a dispersant is taken into consideration, its object with high compatibility with color material is good, and if such resin takes the effectiveness as a binder into consideration, its object which is a solid-state at a room temperature, or is very a hyperviscous liquid in a resin simple substance is desirable. Although especially the class of resin is not the object limited if it is the object which fills such a demand, the resin of a hydrocarbon system, alkyd resin,

acrylic resin, etc. are mentioned as a suitable object, for example. the ink of this invention – as for the concentration of the resin to kick, it is desirable that it is the range of 1 - 15-% of the weight ** especially preferably 0.1 to 20% of the weight to the total amount of ink. The effectiveness of raising the dispersibility of color material if the concentration of resin becomes less than 0.1 % of the weight, or the effectiveness of raising fixable [of the color material to a record medium] is not almost, the inclination for the viscosity of ink to increase and for it to become impossible to perform the stable ink regurgitation when [than 20 % of the weight] more arises, and neither is desirable.

[0029] Furthermore, it is desirable to add an electrification control agent to the ink jet ink in this invention, in order to electrify color material in the polarity of arbitration and the amount of charges. As an electrification control agent, the metallic soap which uses a naphthenic acid, octylic acid, stearin acid, etc. as a fatty-acid component, the metal salt of alkyl sulfuric acid, the metal salt of an alkyl phosphoric acid, a fatty acid, lecithin, etc. can be used, and the resin of fusibility may also function on the above solvents as an electrification control agent. Especially when electrifying color material in straight polarity, metallic soap is desirable, and since having high solubility especially also to the aliphatic hydrocarbon solvent of the very low (less than 30) high grade of a KAURI butanol value and the effectiveness of electrifying a pigment are high, especially the metallic soap that uses a naphthenic acid and octylic acid as a fatty-acid component is desirable. As a metal atom of these metallic soap, manganese, lead, zinc, calcium, aluminum, a zirconium, copper, iron, etc. are usable. As an example of desirable metallic soap, there are manganese naphthenate, naphthenic-acid iron, naphthenic-acid nickel, a naphthenic-acid zirconium, octylic acid manganese, octylic acid iron, octylic acid nickel, an octylic acid zirconium, etc. Under the structure of a pigment and resin, or the effect of surface treatment, even if it does not add especially an electrification control agent, color material may be charged, but if such an electrification control agent is used, while becoming possible to electrify color material more certainly and effectively, it becomes possible to adjust the volume resistivity of the amount of electrifications and F-potential of color material, and ink with the addition. As for the concentration of the electrification control agent in this invention, it is desirable that it is 0.001 - 2.0% of the weight of the range to the total amount of ink. The effectiveness which will give sufficient amount of electrifications for color material if there is less concentration of metallic soap than 0.001 % of the weight is small, and since the inclination for printing concentration to fall will arise for volume-resistivity lowering of ink if [than 2.0 % of the weight] more, neither is desirable.

[0030] Although the fundamental component in this invention is the above mentioned, additives, such as a dispersant, a surfactant, a wax, and a color, may be added suitably. However, the volume resistivity of ink needs to warn against becoming it being desirable and lower than 107 ohm-m 106 ohm-m at this time.

[0031] Next, the creation approach of ink is explained. Production of ink can be performed like production processes, such as various common pigment system ink and a toner. For example, a pigment is added to a solvent at the object which carried out the mixed dissolution so that it may become the suitable viscosity range about the auxiliary additive of resin, metallic soap, a dispersant, and others. Using dispersers, such as a bead mill, attritor, a ball mill, and a paint shaker, by carrying out preferential grinding from several hours for about dozens hours After producing the concentration liquid of the ink in which hundreds of nm - about several micrometers color material was distributed, there is the approach of diluting with distributed twice to the predetermined concentration at the time of using it, and producing ink.

[0032] By the above ingredients and production approaches, by producing ink using the hydrocarbon system solvent of 77-92 degrees C of aniline points as a solvent, regurgitation stability is high, it has a high response frequency, and very little ink for electrostatic type ink jet recording devices of an odor can be produced.

[0033]

[Example] Next, an example explains this invention.

[0034] (Example 1) p-methyl styrene / isobutyl methacrylate / 7.50g (a mole ratio describes 55/35/10 and following resin a) of 2-ethylhexyl acrylate copolymers, and octylic acid zirconium 0.060g were added to mull KAZORUR (trade name) which is the Maruzen Petrochemical high grade isoparaffin system solvent, and

63.7g, and mixed stirring was carried out at the room temperature until Resin a and an octylic acid zirconium dissolved thoroughly. Here, according to the data of manufacturer issuance, mull KAZORU R is isoparaffin 100% (trial by the gas chromatography), the aniline point is 87.8 degrees C and a boiling range is 178.5-181 degrees C. After adding Heliogen Blue D7072DD which is a copper-phthalocyanine-blue pigment by BASF A.G., and 3.75g to this mixed solution, it put into the grinding container made from agate with the bead made from a zirconia with a diameter of 1mm, preferential grinding was carried out for 4 hours using the paint shaker, and cyanogen pigment dispersion liquid of 5.0% of pigment concentration were produced. These pigment dispersion liquid were diluted with mull KAZORU R (trade name), and the ink A of the following presentations was produced.

[0035]

Mull KAZORUR 92.5 % of the weight Heliogen Blue D7072DD 2.5 % of the weight Resin a 5.0 % of the weight Octylic acid zirconium Ink A had the volume resistivity of 107 or more ohm-m 0.04% of the weight. Here, it carried out to measurement of a volume resistivity in the 25-degree C thermostat using the key lathe 6517 mold quantity resistance system (trade name) and the electrode for Oriental vacuum industrial 1 mold liquid electric resistance measurement (trade name). Moreover, when the F-potential of a pigment was measured using the Otsuka electronic ELS-6000 mold F-potential meter (trade name), it had plus 120mV and a value high enough. On the occasion of measurement of F-potential, ink was diluted with the solvent (this example mull KAZORUR) about 1000 times, and it carried out here by introducing into the measurement cell for low dielectric constants held at 25 degrees C. moreover, the organoleptics by 30 adult man and woman who have good health condition about the odor of ink – carrying out – 4: – almost – no odor (especially good), a 3:low smell (good), 2:owner smell (defect), and 1: – if 30 persons' average is rounded off as a result of evaluating in four steps of a tight owner smell (defect) – 4: – almost was judged to be no odor. The Measuring condition of these physical-properties values and the assessment conditions of an odor are the same also about the following examples and examples of a comparison.

[0036] this ink A – the following electrostatic type ink jet heads – using – the regurgitation – printing assessment was carried out.

[0037] Here, drawing 1 is the perspective view showing the configuration of the electrostatic type ink jet head used for assessment of the ink in this example.

[0038] The metal record electrode for giving the electrical-potential-difference pulse from which 1 becomes an ink jet head in ink, and 2 becomes a record signal in drawing 1, and making a liquid ink drop breathe out, The electrode substrate with which the record electrode 2 of plurality [3] was formed, the head block superior lamella of the product [4] made from plastics, The head block inferior lamella made from plastics with 5 [same] and 6 are formed of the head block superior lamella 4 and the head block inferior lamella 5. The ink restoration section connected with the ink tank (not shown) in ink passage (not shown), Opening of the shape of a slit in which 7 was formed of head block superior lamella 4 edge and head block inferior lamella 5 edge, A migration electrode for 8 to make the color material in ink migrating near the record electrode point efficiently, the metal counterelectrode which 9 countered the record electrode 2 and has been arranged, and 10 are the forms stuck to a counterelectrode, and are the longitudinal direction of the ink jet head 1, and the recording paper arranged movable vertically. From ink passage (not shown), the ink restoration section 6 is filled up with the supplied ink (not shown), and it forms a meniscus in opening 7 between ink block superior lamella 4, electrode substrate 3, and record electrode 2 heads. In this example, the width of face of about 150 micrometers and the record electrode 2 used the object with which array spacing of about 60 micrometers and the record electrode 2 set spacing of about 85 micrometers, record electrode 2 head, and the recording paper to 0.7mm, spacing, i.e., the slit width, between head block superior lamella 4 edge and the electrode substrate 3. In using the ink which distributed the color material of plus electrification nature in the ink jet head of such a configuration Always impressing a fixed minus electrical potential difference to a counterelectrode 9, and impressing fixed positive voltage to the migration electrode 8 further By impressing the electrical-potential-difference pulse of plus used as a record signal to the record electrode 2 on a fixed

frequency, moving the detail paper 10 at right angles to the longitudinal direction of the ink jet head 1 From the head of the record electrode 2, an ink droplet is made to breathe out with electrostatic attraction toward a counterelectrode 9, and the dot of a period fixed in the shape of the recording paper is formed.

[0039] Using this ink jet head, about Ink A, the copy paper was followed on condition that the counterelectrode electrical potential difference of -1.2kV, record electrode voltage +400V, and migration electrode voltage +200V, dot printing was performed, and the stability, the responsibility to a record frequency, and printing concentration (optical density) of the regurgitation were evaluated. It was prodigal to measurement of reflection density, and tag concentration meter D19C was used for it. Consequently, it was possible to have recorded uniform dot ** with few blots on stability without a dot omission with the record frequency of 2kHz by printing concentration more than marketing ink jet printer being equivalent called 1.4 or more optical density. Moreover, when the situation near the record electrode point was observed with the optical microscope about the ink jet head after repeating printing of 50,000 dots 10 times on both sides of the pause for [in the condition of having released the ink jet head] 10 minutes, fixing of color material did not have *****.

[0040]

[A table 1]

	インク名	溶媒				印字評価	臭気
		商品名	組成分類	アニリン点 (°C)	沸点範囲 (°C)		
実施例 1	A	マルカゾールR	イソパラフィン	88	179 ~ 181	◎	4
実施例 2	B	シェルゾール70	イソパラフィン	77	168 ~ 183	◎	4
実施例 3	C	IPソルベント1620	イソパラフィン	81	188 ~ 202	◎	4
実施例 4	D	シェルゾール72	イソパラフィン	86	215 ~ 248	◎	4
実施例 5	E	日石アイソゾール400	イソパラフィン	87	210 ~ 254	◎	4
実施例 6	F	アイソパーM	イソパラフィン	90	218 ~ 263	◎	4
実施例 7	G	NORPAR 12	ノルマルパラフィン	82	188 ~ 217	◎	4
実施例 8	H	NORPAR 13	ノルマルパラフィン	87	226 ~ 242	◎	4
実施例 9	I	NORPAR 15	ノルマルパラフィン	92	252 ~ 272	○	4
実施例 10	J	エクソールD110	パラフィン/ナフテン混合	82	243 ~ 272	○	3
実施例 11	K	エクソールD130	パラフィン/ナフテン混合	90	277 ~ 310	○	3
比較例 1	L	IPソルベント1016	イソパラフィン	72	73 ~ 140	×	3
比較例 2	M	アイソパーV	イソパラフィン	96	274 ~ 314	×	4
比較例 3	N	IPソルベント2836	イソパラフィン	104	277 ~ 353	×	4
比較例 4	O	エクソール030	パラフィン/ナフテン混合	64	141 ~ 164	×	2

[0041] (A table 1) is the list of the physical-properties value of the solvent in the examples 2-11 and the examples 1-4 of a comparison which are shown an example 1 and henceforth, and the assessment results of printing and an odor.

[0042] When the record frequency which a with an optical density of 1.4 or more dot can print at the less than 0.05% as a commercial ink jet printer with the same probability of occurrence of a dot omission was 2kHz or more, they were O (especially good) and 1kHz or more less than 2kHz and the term of printing assessment here was not able to perform O (good), 1kHz or less, or stable printing, it was made into x (defect). The term of an odor shows the result of the four-step assessment in the above-mentioned organic-functions assessment, and can be judged that the case of three or more is good. The assessment conditions of the above-mentioned printing assessment, an odor, and a color-material fixing condition are the same also about the following examples 2-11 and examples 1-4 of a comparison.

[0043] (Examples 2-6) Instead of mull KAZORU R in the ink A of an example 1 Shell ZORU 70 (trade name) made from shell JAPAN, the IP solvent 1620 (trade name) made from the Idemitsu petrochemistry, Ink B, C, D, E, and F was produced like the example 1, using respectively shell ZORU 72 (trade name) made from shell JAPAN, eye SOZORU 400 (trade name) made from the Nippon Oil chemistry, and Isopar M made from Exxon chemistry (trade name) as a solvent. Each of these solvents is isoparaffin 100%.

[0044] Each ink B-F had the volume resistivity of 107 or more ohm-m, and high F-potential like Ink A.

[0045] The result of having performed the same printing assessment as the aniline point of each solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about ink B-F. Thus,

it had the good property like [any ink] Ink A. Moreover, also when which ink was used, color-material fixing in the record electrode point of the ink jet head after printing assessment did not have *****.

[0046] (Examples 7-9) Ink G, H, and I was produced like the example 1, using respectively the no pars 12, 13, and 15 (trade name) which are normal paraffin 100% [made from Exxon chemistry] solvents as a solvent. Each of these ink had the volume resistivity of 10⁷ or more ohm-m, and high F-potential like Ink A.

[0047] The result of having performed the same printing assessment as the aniline point of each solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about ink G-I. Thus, the property with any good ink was shown. However, Ink I has a low regurgitation frequency compared with less than 2kHz and the above and other examples, and can consider viscosity lifting of the ink by having used the solvent with a high boiling range as this cause. Moreover, also when which ink was used, color-material fixing in the record electrode point of the ink jet head after printing assessment did not have *****.

[0048] (Examples 10 and 11) Instead of mull KAZORU R in the ink A of an example 1, Ink J and K was produced like the example 1, using respectively EKUSORU D110 and D130 (trade name) which is the paraffin / naphthene partially aromatic solvent made from Exxon chemistry as a solvent. Each of these ink had the volume resistivity of 10⁷ or more ohm-m, and high F-potential like Ink A. The result of having performed the same printing assessment as the aniline point of each solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about Ink J and K. Thus, although it had the property with any good ink, as compared with the example 1, the response frequency was low. It is thought that this is based on viscosity lifting of the ink by having used the solvent with a high boiling range like the case of Ink I. An odor is considered that an odor is a little strong as compared with ink A-I using an isoparaffin solvent or a normal paraffin solvent, and this is because the amount of a lot of naphthenes exist in a solvent. Moreover, most affixes were not checked by the record electrode point of the ink jet head after printing assessment also when which ink was used.

[0049] (Example 1 of a comparison) Instead of mull KAZORU R in the ink A of an example 1, Ink L was produced like the example 1, using as a solvent the IP solvent 1620 (trade name) which is an isoparaffin 100% [made from the Idemitsu petrochemistry] solvent.

[0050] Ink L all had the volume resistivity of 10⁷ or more ohm-m, and high F-potential like Ink A.

[0051] The result of having performed the same printing assessment as the aniline point of a solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about Ink L. Thus, in Ink L, a good printing result was not obtained but the fixing object was further checked by the record electrode point of the ink jet head after printing assessment. Moreover, as compared with ink A-I using the isoparaffin system which has a boiling range 150 degrees C or more, or a normal paraffin system solvent, the odor was sensed strong a little.

[0052] (Examples 2 and 3 of a comparison) Instead of mull KAZORU R in the ink A of an example 1, Ink M and N was produced like the example 1, using respectively the IP solvent 2835 (trade name) which are Isopar V (trade name) which is an isoparaffin 100% solvent made from Exxon chemistry, and an isoparaffin 100% [made from the Idemitsu petrochemistry] solvent as a solvent.

[0053] Ink M and N all had the volume resistivity of 10⁷ or more ohm-m, and high F-potential like Ink A.

[0054] The result of having performed the same printing assessment as the aniline point of each solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about Ink M and N. Thus, although any ink was good about the odor, a good printing result was not obtained. when this had too high aniline point and boiling range of a solvent, the viscosity of ink became high too much – it is thought that it comes out. Also when which ink was used, color-material fixing in the record electrode point of the ink jet head after printing assessment did not have *****.

[0055] (Example 4 of a comparison) Instead of mull KAZORU R in the ink A of an example 1, Ink O was produced like the example 1, using as a solvent EKUSORU D30 (trade name) which is the paraffin / naphthene partially aromatic solvent made from Exxon chemistry. Ink O all had the volume resistivity of 10⁷ or more ohm-m, and high F-potential like Ink A.

[0056] The result of having performed the same printing assessment as the aniline point of a solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about Ink O. Thus, in Ink O, a good printing result was not obtained but the fixing object was further checked by the record electrode point of the ink jet head after printing assessment. Moreover, a good result was not obtained about the odor.

[0057] As the above example and example of a comparison showed, in ink using the hydrocarbon system solvent whose aniline point is 77-92 degrees C as a solvent, there are few odors and they can realize high printing of a response frequency to stability. Moreover, at 150-260 degrees C, if a boiling range uses the hydrocarbon system solvent whose aniline point is 77-92 degrees C, it can realize high printing of especially a response frequency. Furthermore, as such a hydrocarbon system solvent, if normal paraffin or isoparaffins are used, it can lessen [odor / of ink] dramatically. Moreover, the mixture of normal paraffin and isoparaffins does not take explanation to the same thing in this case, either.

[0058]

[Effect of the Invention] As mentioned above, according to this invention, it has the outstanding printing engine performance and the electrostatic type ink jet record approach and equipment using the ink jet ink suitable for the activity by still more general home and office environment and it can be realized.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the electrostatic type ink jet record approach and recording device which used ink jet ink and it.

PRIOR ART

[Description of the Prior Art] The ink jet recording method for printing by making ink fly to a record medium and forming a record dot is easy to colorize, and is attracting the interest in the regular paper as a non impact recording method which can carry out direct record, and the printer using this method is put in practical use variously. There is the ink jet recording method of an electrostatic type impress an electrical potential difference to two or more record electrodes which countered the record medium and have been arranged as one of the ink jet recording methods, and the counterelectrode arranged at the tooth back of a record medium, make electrostatic force act on the ink supplied on the record electrode, and make ink fly on a record medium according to the potential difference produced between two electrodes. These electrostatic ink jet printers are introduced to a "ink jet record technique" and Triceps Issuance (1989).

[0003] an example of the full color recording head of the drop mold on demand constituted by such electrostatic ink jet method – JP,58-215253,A, an institute-of-telecommunications-engineers paper magazine, Vol.J68-C, and 2 (1985) – it is indicated and announced by the 100th page from the 93rd page. [for example,] This method uses for the wall the ink delivery of the shape of a long and slender slit which has many record electrodes instead of the nozzle in the conventional ink jet head. For this reason, it is an effective approach also in order to realize the so-called long line head of the die length which can expect reduction of a manufacturing cost according to there being few fears of receiving the blinding of ink, and the configuration of a head being simple, and can cover the large area of the cross direction of a record medium. In this electrostatic type ink jet head Although the oily ink which dissolved the color in the organic solvent is used suitably and indicated by the detail about the component of ink In the example seen in an institute-of-telecommunications-engineers paper magazine, Vol.J68-C, 2, pp.93-100, and (1985), the ink in which 105 - 106 ohm-m and surface tension have 22 mN/m, and viscosity has [a volume resistivity (electrical resistivity)] the physical-properties value of 3.1-6.9cP is used. However, since surface tension was low as compared with the water color ink generally used in other Inn Jet methods, such oily ink had the dramatically

large permeability to the recording paper, and when printing especially in a regular paper, it had the problem of being easy to produce lowering of printing concentration, a blot, and flesh-side projection.

[0004] On the other hand, JP,9-11475,A, JP,9-118015,A, and JP,9-193389,A are made to concentrate a color-material particle on the discharge part at the head of a discharge electrode by electrophoresis, and the electrostatic ink jet head which makes an ink droplet fly in the form where color material was condensed at high concentration is indicated by the electrostatic field by which the electrified color-material particle (toner) was formed between the discharge electrode and the counterelectrode using the ink distributed in the high liquid of electric insulation at them, for example. In this case, the potential of the electrification polarity of color material and like-pole nature is given to a discharge electrode, and the potential of the electrification polarity and reversed polarity of color material is usually given to a counterelectrode. By this method, although the detail of that regurgitation principle is not clarified, an above-mentioned trouble is solved by unlike the above-mentioned method, not being breathed out while the constituent of ink had contained a lot of liquid components in the uniform condition, but color material's condensing, and breathing out ink in the condition with few liquid components. Moreover, compared with the ink jet head using the conventional color, an advantageous result is obtained also about the water resisting property of a printing image, and lightfastness by using a pigment as a color material.

[0005] In the electrostatic ink jet ink of such a color-material condensation mold, printing concentration is high, and in order to acquire the good printing property which produces neither a blot nor flesh-side projection, it is required 1st for the volume resistivity of ink to be large enough first. It becomes possible to make the electric field which were formed with the record electrode and the counterelectrode of this thing, and were impressed to ink reach a color-material particle. Moreover, if the volume resistivity of ink is low, with the electrical potential difference impressed with a record electrode, ink will receive charge impregnation, and will be charged, and the inclination breathed out while ink had contained a lot of liquid components according to electrostatic repulsion will become strong. Next, in order to centralize a color-material particle on the delivery section by electrophoresis at sufficient rate, it is required to have amount of electrifications with a sufficient color-material particle, i.e., for the color-material particle to have the high F-potential of straight polarity or negative polarity. Moreover, it is supposed from the balance of discharging performance and sedimentation prevention of a color-material particle that the mean particle diameter of a color-material particle is desirable about 0.1-4 micrometers.

[0006] Specifically, the activity of the ink in which electrical resistivity was adjusted more than 106ohm and m into the dielectric liquid of 108 or more ohm-m by distributing the developer particle (hard resin particle which has a coloring matter component at least) in within the limits whose F-potential to said dielectric liquid is 60mV or more and, whose mean particle diameter is 5 micrometers of 0.01 **** so that it might have the electrical resistivity of 108 or more ohm-m most preferably is indicated by JP,9-193389,A. Such ink as the hydrocarbon system solvent which has the volume resistivity of 108 or more ohm-m as for example, an insulating liquid, and a color material Although it is thought possible to prepare by producing a color-material dispersing element by the system which added the dispersant, the electrification control agent, etc. to the inside of the binder which becomes a carbon black pigment and an organic pigment, and a list from resin or a wax, or a front face, using the thing containing a pigment The detail of a suitable presentation and suitable ingredient of ink, the production approach, and an ink physical-properties value is not indicated.

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, according to this invention, it has the outstanding printing engine performance and the electrostatic type ink jet record approach and equipment using the ink jet ink suitable for the activity by still more general home and office environment and it can be realized.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In the electrostatic ink jet recording method of the above color-material condensation molds Using the ink of a configuration of having distributed the color-material particle in the non-aqueous solvent to the discharge part at the head of a discharge electrode established in the substrate up which forms slit-like opening The configuration which makes an ink droplet fly in the form where centralized the color-material particle in ink by electrophoresis, and color material was condensed by high concentration sake, In volatilization of the non-aqueous-solvent solvent from opening, and the color-material particle list to a discharge electrode, by adhesion of an impurity etc. Hyperviscosity-izing of ink, fixing (sticking) of a color-material particle, etc. occurred, and there was a problem that the regurgitation of ink became instability or the response frequency of the ink regurgitation fell. [/ near the discharge electrode point] Moreover, although volatilization of the solvent from opening was controlled when molecular weight used the volatile low high solvent, there was a problem that the regurgitation of ink became instability similarly or the response frequency of the ink regurgitation fell by the fluid lowering and the migration rate lowering of a color-material particle by hyperviscosity-izing of ink. Furthermore, in order to use a non-aqueous solvent, the odor occurred according to causes, such as a content of the molecular structure of a solvent, volatility, and an impurity, and there was a case where it became a problem on the occasion of the activity by a general home and office environment especially.

[0008] This invention is an object which solves the above-mentioned conventional trouble, has the outstanding printing engine performance and aims at offering the electrostatic type ink jet record approach and equipment using the ink jet ink suitable for the activity by still more general home and office environment, and it.

MEANS

[Means for Solving the Problem] The ink jet ink of this invention has the configuration which contains a color material insoluble to said non-aqueous solvent at least in the non-aqueous solvent of electric insulation, and considered it as the configuration said whose solvent is the hydrocarbon system solvent of 77-92 degrees C of aniline points.

[0010] According to this invention, it has the outstanding printing engine performance and the ink jet ink suitable for the activity by still more general home and office environment can be realized.

[0011]

[Embodiment of the Invention] Invention of this invention according to claim 1 has the configuration which contains a color material insoluble to a non-aqueous solvent at least in the non-aqueous solvent of electric insulation. It is ink jet ink which has the volume resistivity of 106 or more ohm-m. While lessening dramatically the content of the naphthenes in the hydrocarbon system solvent which is ink jet ink characterized by a solvent being the hydrocarbon system solvent of 77-92 degrees C of aniline points, and is a solvent, and aromatic series It has an operation of making into the suitable range molecular weight of the hydrocarbons which constitute a solvent.

[0012] In claim 1, invention of this invention according to claim 2 is ink jet ink in which the boiling range of a hydrocarbon system solvent is characterized by being 150-260 degrees C, and has an operation of making the volatility of an ink solvent and viscosity in a room temperature into the suitable range.

[0013] In claims 1 and 2, invention of this invention according to claim 3 is ink jet ink characterized by hydrocarbon system solvents being normal paraffin, isoparaffins, or those mixture, and has an operation that there is very small the odor of ink.

[0014] Invention of this invention according to claim 4 77-92 degrees C of aniline points, and 150-260 degrees

C of boiling ranges, Normal paraffin, isoparaffins, or those mixture are used as a solvent. It is ink jet ink characterized by having a configuration containing a color material insoluble to a solvent at least, and having the volume resistivity of 107 or more ohm-m. While there are dramatically few contents of the aromatic series in a solvent and an impurity, it has the volatility of the suitable range, and viscosity in a room temperature and an odor enables production of very small ink jet ink, it has an operation of enabling formation of few record images of a blot by high concentration.

[0015] Invention of this invention according to claim 5 introduces ink jet ink claim 1 - given [any 1] in four into the recording head by which the record electrode has been arranged. By impressing an electrical potential difference between the counterelectrodes which countered the record electrode and the record electrode and have been arranged, and making electrostatic force act on said ink It is the electrostatic type ink jet record approach characterized by recording by forming a printing dot on the record medium which said ink was made to fly and has been arranged between a record electrode and a counterelectrode from the recording head. Since it has the volatility of the suitable range, and viscosity in the room temperature, while the regurgitation of ink is stable It has an operation of it being possible to control lowering of the response frequency of the ink regurgitation, and the odor of ink being also very small, and enabling formation of few record images of a blot by high concentration.

[0016] The recording head by which, as for invention of this invention according to claim 6, the record electrode has been arranged at least, Have the counterelectrode which countered the record electrode and has been arranged and ink jet ink claim 1 - given [any 1] in four is introduced into the recording head by which the record electrode has been arranged. By impressing an electrical potential difference between the counterelectrodes which countered the record electrode and the record electrode and have been arranged, and making electrostatic force act on ink It is the electrostatic type ink jet recording device characterized by recording by forming a printing dot on the record medium which ink was made to fly and has been arranged between a record electrode and a counterelectrode from the recording head. Since it has the volatility of the suitable range, and viscosity in the room temperature, while the regurgitation of ink is stable It has an operation of it being possible to control lowering of the response frequency of the ink regurgitation, and the odor of ink being also very small, and enabling formation of few record images of a blot by high concentration.

[0017] Hereafter, the gestalt of operation of this invention is explained.

[0018] The ink jet ink of this invention has the configuration which contains a color material insoluble to said non-aqueous solvent at least in the non-aqueous solvent of electric insulation as mentioned above, and is characterized by said solvent being the hydrocarbon system solvent of 77-92 degrees C of aniline points. First, the solvent which is the description of this invention is explained to a detail.

[0019] In the electrostatic ink jet recording device of a color-material condensation mold which was described previously Since high volume resistivities, such as more than 107ohm and m, are preferably required of ink more than 106ohm and m, Although it is thought from demand that the solvent to be used needs that it is necessary to have the volume resistivity of 108 or more ohm-m extent and, and for reactivity to be low stable and for safety to be high that a polar low hydrocarbon system solvent is suitable It is characterized [greatest] by using for the ink of this invention as a solvent the hydrocarbon system solvent whose aniline point is 77-92 degrees C.

[0020] Here, the aniline point of a hydrocarbon system solvent is explained. The aniline point means the minimum temperature which a hydrocarbon or hydrocarbon mixture dissolves mutually with the aniline of an isochore product, and may exist as a uniform solution. The aniline point has the close relation to the class of hydrocarbon, and molecular weight, if it is equal molecular weight, paraffin is the highest, naphthenes are lower than it, and aromatic series shows the minimum value. Moreover, in a congeneric train, it becomes such a high value that molecular weight becomes large. Since the aniline point becomes low so that contents currently mixed in the paraffin which followed, for example, was refined in a certain fixed boiling range, such as naphthenes and aromatic series, increase, it is used as an index of whenever [purification / of paraffin]. Moreover, if the presentation of hydrocarbons is equal, in order to be dependent on the molecular weight,

there is close relation to the vapor rate (volatility) of a hydrocarbon system solvent and viscosity. The aniline point test approach of a petroleum product is JIS. K It is specified to 2256.

[0021] In the electrostatic ink jet recording device of a color-material condensation mold, as stated previously, hyperviscosity-izing of ink, fixing of a color-material particle, etc. occurred, and there was a problem that the regurgitation of ink became instability or the response frequency of the ink regurgitation fell. [/ near the discharge electrode point] This is considered that adhesion of an impurity is the cause by the color-material particle list to volatilization of the solvent from opening, or a discharge electrode. Although volatilization of the solvent from opening is controlled if molecular weight uses an volatile low high solvent, the problem that the regurgitation of ink becomes instability similarly or the response frequency of the ink regurgitation falls by the fluid lowering and the migration rate lowering of a color-material particle by hyperviscosity-izing of ink may arise. By using as a solvent the hydrocarbon system solvent whose aniline point is 77-92 degrees C, these problems are solved, regurgitation stability is high and ink with a high response frequency can be realized. This is making the aniline point of an ink solvent into within the limits of 77-92 degrees C, and is considered to be because for the volatility of a solvent, an impurity content, and viscosity to have been adjusted in the desirable range. Furthermore, since the odor of ink decreases dramatically by this thing, the ink of this invention is an object suitable for the activity by a general home and office environment. If the aniline point becomes lower than 77 degrees C, since the content of aromatic series is high, the object especially whose aniline point is less than 60-degree-C extent preferably since the volatility of a solvent or the content of an impurity becomes high too much has a strong odor, and it is not desirable from the field of stability and safety. Moreover, if the aniline point exceeds 92 degrees C, while the volatility of a solvent will become small too much, since viscosity becomes high too much, it is not desirable.

[0022] Moreover, if that whose boiling range is 150-260 degrees C is used with the hydrocarbon system solvent in the range whose aniline point is 77-92 degrees C, high regurgitation stability and a response frequency can be realized and the especially excellent engine performance will be obtained. Since the volatility of a solvent will become high too much and it will become easy to produce color-material fixing etc., if a boiling range becomes lower than 150 degrees C, if the ink regurgitation tends to become instability and a boiling range becomes higher than 260 degrees C, since the viscosity of a solvent is high, the inclination for a regurgitation response frequency to fall will arise. Generally, the boiling point of a petroleum solvent is expressed at a distillation range, i.e., the initial boiling point (degree C) and the dry point (degree C), or a terminal point (degree C), and its definition of the boiling range in this invention is also synonymous with this.

[0023] Generally the hydrocarbon system solvent which has the above descriptions is an aliphatic series system solvent, an aromatic solvent is not contained, but although it is either or those mixture of normal paraffin, isoparaffins, and naphthenes, since there are more few odors as compared with naphthenes, if normal paraffin and isoparaffins use the mixture of normal paraffin, an isoparaffin pole, or both, they can more specifically be used [odor] as an edge few mainly. Although the mixture of normal paraffin here, isoparaffins, or both means the solvent which uses as a principal component mixture of the normal paraffin refined by altitude, isoparaffins, or both, the naphthenes of the minute amount of extent and aromatic series are mixed also in these solvents generally dramatically refined by altitude a maximum of 0.5% or less from ppm level. However, the effect which the component of these minute amounts has on an odor can be disregarded mostly very small. Therefore, the mixture of normal paraffin here, isoparaffins, or both means what does not contain the naphthenes and aromatic series of an amount more than the above minute-impurities level.

[0024] The solvent using the hydrocarbon system solvent in the ink jet ink of this invention As an example of the hydrocarbon system solvent of marketing which is in within the limits whose aniline point is 77-92 degrees C that what is necessary is just the object which fills the above demands although it is not the object limited especially Isopar G, H, L, and M (trade name) which is an isoparaffin system solvent made from Exxon chemistry, The no pars 12, 13, and 15 (trade name) which are the isoparaffin system solvents made from Exxon chemistry, EKUSORU D110 and D130 (trade name) which is the paraffin / naphthene mixed stock solvent made from Exxon chemistry, The IP solvents 1620 and 2028 (trade name) which are the isoparaffin

system solvents made from the Idemitsu petrochemistry, The normal paraffin SL, L, M, and H (trade name) which is a normal paraffin system solvent made from the Nippon Oil chemistry, Eye SOZORU 300,400 (trade name) which is an isoparaffin system solvent made from the Nippon Oil chemistry, Mull KAZORUR which is the Maruzen Petrochemical isoparaffin system solvent (trade name) There are shell ZORU 70 which is an isoparaffin system solvent made from shell JAPAN, shell ZORU 71, shell ZORU 72 (trade name), and shell ZORU D100 (trade name) that is the paraffin / naphthene mixed stock solvent made from shell JAPAN. These hydrocarbon system solvent products have the high volume resistivity of at least 1010 or more ohm-m. Furthermore, reactivity is low stable, by low toxicity, safety is high and an odor also has the description of being few. Among these, the thing in the range whose boiling range is 150-260 degrees C Isopar G, H, L, and M (trade name), the no pars 12 and 13 (trade name), The IP solvent 1620 (trade name), normal paraffin SL, L, and M, Eye SOZORU 300,400 (trade name), mull KAZORUR (trade name) What is shell ZORU 70, shell ZORU 71, and shell ZORU 72, and is normal paraffin, isoparaffins, or those mixture Isopar G, H, L, and M (trade name), the no pars 12, 13, and 15 (trade name), They are the IP solvents 1620 and 2028 (trade name), normal paraffin SL, L, M, and H (trade name), eye SOZORU 300,400 (trade name), mull KAZORUR (trade name), shell ZORU 70, shell ZORU 71, and shell ZORU 72. furthermore, as an object applicable to normal paraffin of 77-92 degrees C of aniline points, and 150-260 degrees C of boiling ranges, isoparaffins, or those mixture Isopar G, H, L, and M (trade name), the no pars 12 and 13 (trade name), The IP solvent 1620 (trade name), normal paraffin SL, L, and M (trade name), If there are eye SOZORU 300,400 (trade name), mull KAZORUR (trade name), shell ZORU 70, shell ZORU 71, and shell ZORU 72 and these products are used, the engine performance which was excellent from especially a reason like point ** will be obtained.

[0025] Although the description of the solvent in the ink of this invention is the following, it is the range which fulfills the demand characteristics of the above ink physical properties on the occasion of ink-izing, and it is little, for example, naturally it is possible to add the matter of fusibility to the solvents and hydrocarbon system solvents other than hydrocarbon system solvents, such as alcohols.

[0026] Then, the ingredient of others which constitute the ink jet ink in connection with this invention is explained.

[0027] As a color material insoluble to a solvent in the ink jet ink of this invention, the thing which made insoluble resin etc. distribute a pigment or a pigment to a solvent, or the thing which graft-ized resin on the pigment front face can be used. As a pigment, inorganic [various] and an organic pigment can be used, for example, there are carbon black, a beta-naphthol system azo pigment, a pyrazolone system azo pigment, an acetoacetic-acid ARIRIDO system azo pigment, a disazo condensation pigment, a disazo pigment, an anthra pyridine pigment, an indanthrene pigment, phthalocyanine pigment, a quinacridone pigment, an indigo pigment, an isoindolinone pigment, a dioxazine pigment, a perylene pigment, a phtalo peri non pigment, a kino FUTARON pigment, a titanium dioxide, etc. Moreover, although well-known nature or synthetic resin can be variously used for a solvent as insoluble resin, there are acrylic resin, an epoxy resin, ethylene-vinyl acetate resin, vinyl chloride-vinyl acetate resin, styrene-butadiene resins, etc., for example. as [see / as the technique of making these resin distribute a pigment / the manufacture process of the toner for electrophotography] – what is necessary is just to use a well-known approach variously In addition, the processing pigment which made rosin ester resin, vinyl chloride-vinyl acetate resin, etc. distribute a pigment particle is marketed, and this may be used. As for the concentration of color material in the ink of this invention, it is desirable that it is 2 - 10% of the weight of the range especially preferably 0.5 to 15% of the weight to the total amount of ink. If the concentration of color material becomes less than 0.5 % of the weight, sufficient printing concentration is not obtained and it is not desirable. Moreover, if it increases more than 15 % of the weight, the inclination for the viscosity of ink to increase remarkably and for it to become impossible to perform the stable ink regurgitation generates and is not desirable.

[0028] While carrying out particle distribution of the above color material into a solvent, meltable resin can be added to a solvent meltable or selectively at raising distributed stability, i.e., the function as a dispersant, and a list by setting the function as raising fixable [of the color material to record media, such as paper,], i.e., a

binder for fixation, as the main object. Preferably, if the effectiveness as a dispersant is taken into consideration, its object with high compatibility with color material is good, and if such resin takes the effectiveness as a binder into consideration, its object which is a solid-state at a room temperature, or is very a hyperviscous liquid in a resin simple substance is desirable. Although especially the class of resin is not the object limited if it is the object which fills such a demand, the resin of a hydrocarbon system, alkyd resin, acrylic resin, etc. are mentioned as a suitable object, for example. the ink of this invention – as for the concentration of the resin to kick, it is desirable that it is the range of 1 - 15-% of the weight ** especially preferably 0.1 to 20% of the weight to the total amount of ink. The effectiveness of raising the dispersibility of color material if the concentration of resin becomes less than 0.1 % of the weight, or the effectiveness of raising fixable [of the color material to a record medium] is not almost, the inclination for the viscosity of ink to increase and for it to become impossible to perform the stable ink regurgitation when [than 20 % of the weight] more arises, and neither is desirable.

[0029] Furthermore, it is desirable to add an electrification control agent to the ink jet ink in this invention, in order to electrify color material in the polarity of arbitration and the amount of charges. As an electrification control agent, the metallic soap which uses a naphthenic acid, octylic acid, stearin acid, etc. as a fatty-acid component, the metal salt of alkyl sulfonic acid, the metal salt of an alkyl phosphoric acid, a fatty acid, lecithin, etc. can be used, and the resin of fusibility may also function on the above solvents as an electrification control agent. Especially when electrifying color material in straight polarity, metallic soap is desirable, and since having high solubility especially also to the aliphatic hydrocarbon solvent of the very low (less than 30) high grade of a KAURI butanol value and the effectiveness of electrifying a pigment are high, especially the metallic soap that uses a naphthenic acid and octylic acid as a fatty-acid component is desirable. As a metal atom of these metallic soap, manganese, lead, zinc, calcium, aluminum, a zirconium, copper, iron, etc. are usable. As an example of desirable metallic soap, there are manganese naphthenate, naphthenic-acid iron, naphthenic-acid nickel, a naphthenic-acid zirconium, octylic acid manganese, octylic acid iron, octylic acid nickel, an octylic acid zirconium, etc. Under the structure of a pigment and resin, or the effect of surface treatment, even if it does not add especially an electrification control agent, color material may be charged, but if such an electrification control agent is used, while becoming possible to electrify color material more certainly and effectively, it becomes possible to adjust the volume resistivity of the amount of electrifications and F-potential of color material, and ink with the addition. As for the concentration of the electrification control agent in this invention, it is desirable that it is 0.001 - 2.0% of the weight of the range to the total amount of ink. The effectiveness which will give sufficient amount of electrifications for color material if there is less concentration of metallic soap than 0.001 % of the weight is small, and since the inclination for printing concentration to fall will arise for volume-resistivity lowering of ink if [than 2.0 % of the weight] more, neither is desirable.

[0030] Although the fundamental component in this invention is the above mentioned, additives, such as a dispersant, a surfactant, a wax, and a color, may be added suitably. However, the volume resistivity of ink needs to warn against becoming it being desirable and lower than 107 ohm-m 106 ohm-m at this time.

[0031] Next, the creation approach of ink is explained. Production of ink can be performed like production processes, such as various common pigment system ink and a toner. For example, a pigment is added to a solvent at the object which carried out the mixed dissolution so that it may become the suitable viscosity range about the auxiliary additive of resin, metallic soap, a dispersant, and others. Using dispersers, such as a bead mill, attritor, a ball mill, and a paint shaker, by carrying out preferential grinding from several hours for about dozens hours After producing the concentration liquid of the ink in which hundreds of nm - about several micrometers color material was distributed, there is the approach of diluting with distributed twice to the predetermined concentration at the time of using it, and producing ink.

[0032] By the above ingredients and production approaches, by producing ink using the hydrocarbon system solvent of 77-92 degrees C of aniline points as a solvent, regurgitation stability is high, it has a high response frequency, and very little ink for electrostatic type ink jet recording devices of an odor can be produced.

EXAMPLE

[Example] Next, an example explains this invention.

[0034] (Example 1) p-methyl styrene / isobutyl methacrylate / 7.50g (a mole ratio describes 55/35/10 and following resin a) of 2-ethylhexyl acrylate copolymers, and octylic acid zirconium 0.060g were added to mull KAZORUR (trade name) which is the Maruzen Petrochemical high grade isoparaffin system solvent, and 63.7g, and mixed stirring was carried out at the room temperature until Resin a and an octylic acid zirconium dissolved thoroughly. Here, according to the data of manufacturer issuance, mull KAZORU R is isoparaffin 100% (trial by the gas chromatography), the aniline point is 87.8 degrees C and a boiling range is 178.5-181 degrees C. After adding Heliogen Blue D7072DD which is a copper-phthalocyanine-blue pigment by BASF A.G., and 3.75g to this mixed solution, it put into the grinding container made from agate with the bead made from a zirconia with a diameter of 1mm, preferential grinding was carried out for 4 hours using the paint shaker, and cyanogen pigment dispersion liquid of 5.0% of pigment concentration were produced. These pigment dispersion liquid were diluted with mull KAZORU R (trade name), and the ink A of the following presentations was produced.

[0035]

Mull KAZORUR 92.5 % of the weight Heliogen Blue D7072DD 2.5 % of the weight Resin a 5.0 % of the weight Octylic acid zirconium Ink A had the volume resistivity of 107 or more ohm-m 0.04% of the weight. Here, it carried out to measurement of a volume resistivity in the 25-degree C thermostat using the key lathe 6517 mold quantity resistance system (trade name) and the electrode for Oriental vacuum industrial 1 mold liquid electric resistance measurement (trade name). Moreover, when the F-potential of a pigment was measured using the Otsuka electronic ELS-6000 mold F-potential meter (trade name), it had plus 120mV and a value high enough. On the occasion of measurement of F-potential, ink was diluted with the solvent (this example mull KAZORUR) about 1000 times, and it carried out here by introducing into the measurement cel for low dielectric constants held at 25 degrees C. moreover, the organoleptics by 30 adult man and woman who have good health condition about the odor of ink – carrying out – 4: – almost – no odor (especially good), a 3: low smell (good), 2: owner smell (defect), and 1: – if 30 persons' average is rounded off as a result of evaluating in four steps of a tight owner smell (defect) – 4: – almost was judged to be no odor. The Measuring condition of these physical-properties values and the assessment conditions of an odor are the same also about the following examples and examples of a comparison.

[0036] this ink A – the following electrostatic type ink jet heads – using – the regurgitation – printing assessment was carried out.

[0037] Here, drawing 1 is the perspective view showing the configuration of the electrostatic type ink jet head used for assessment of the ink in this example.

[0038] The metal record electrode for giving the electrical-potential-difference pulse from which 1 becomes an ink jet head in ink, and 2 becomes a record signal in drawing 1, and making a liquid ink drop breathe out, The electrode substrate with which the record electrode 2 of plurality [3] was formed, the head block superior lamella of the product [4] made from plastics, The head block inferior lamella made from plastics with 5 [same] and 6 are formed of the head block superior lamella 4 and the head block inferior lamella 5. The ink restoration section connected with the ink tank (not shown) in ink passage (not shown), Opening of the shape of a slit in which 7 was formed of head block superior lamella 4 edge and head block inferior lamella 5 edge, A migration electrode for 8 to make the color material in ink migrating near the record electrode point efficiently, the metal counterelectrode which 9 countered the record electrode 2 and has been arranged, and 10 are the forms stuck to a counterelectrode, and are the longitudinal direction of the ink jet head 1, and the recording paper arranged movable vertically. From ink passage (not shown), the ink restoration section 6 is filled up with the supplied ink (not shown), and it forms a meniscus in opening 7 between ink block superior lamella 4,

electrode substrate 3, and record electrode 2 heads. In this example, the width of face of about 150 micrometers and the record electrode 2 used the object with which array spacing of about 60 micrometers and the record electrode 2 set spacing of about 85 micrometers, record electrode 2 head, and the recording paper to 0.7mm, spacing, i.e., the slit width, between head block superior lamella 4 edge and the electrode substrate 3. In using the ink which distributed the color material of plus electrification nature in the ink jet head of such a configuration Always impressing a fixed minus electrical potential difference to a counterelectrode 9, and impressing fixed positive voltage to the migration electrode 8 further By impressing the electrical-potential-difference pulse of plus used as a record signal to the record electrode 2 on a fixed frequency, moving the detail paper 10 at right angles to the longitudinal direction of the ink jet head 1 From the head of the record electrode 2, an ink droplet is made to breathe out with electrostatic attraction toward a counterelectrode 9, and the dot of a period fixed in the shape of the recording paper is formed.

[0039] Using this ink jet head, about Ink A, the copy paper was followed on condition that the counterelectrode electrical potential difference of -1.2kV, record electrode voltage +400V, and migration electrode voltage +200V, dot printing was performed, and the stability, the responsibility to a record frequency, and printing concentration (optical density) of the regurgitation were evaluated. It was prodigal to measurement of reflection density, and tag concentration meter D19C was used for it. Consequently, it was possible to have recorded uniform dot ** with few blots on stability without a dot omission with the record frequency of 2kHz by printing concentration more than marketing ink jet printer being equivalent called 1.4 or more optical density. Moreover, when the situation near the record electrode point was observed with the optical microscope about the ink jet head after repeating printing of 50,000 dots 10 times on both sides of the pause for [in the condition of having released the ink jet head] 10 minutes, fixing of color material did not have *****.

[0040]

[A table 1]

	インク名	溶媒				印字評価	臭気
		商品名	組成分類	アニリン点 (°C)	沸点範囲 (°C)		
実施例 1	A	マルカゾールR	イソパラフィン	88	179 ~ 181	◎	4
実施例 2	B	シェルゾール70	イソパラフィン	77	158 ~ 183	◎	4
実施例 3	C	IPソルベント1820	イソパラフィン	81	166 ~ 202	◎	4
実施例 4	D	シェルゾール72	イソパラフィン	85	215 ~ 248	◎	4
実施例 5	E	日石アイソゾール400	イソパラフィン	87	210 ~ 254	◎	4
実施例 6	F	アイソパーM	イソパラフィン	90	218 ~ 253	◎	4
実施例 7	G	NORPAR 12	ノルマルパラフィン	82	188 ~ 217	◎	4
実施例 8	H	NORPAR 13	ノルマルパラフィン	87	226 ~ 242	◎	4
実施例 9	I	NORPAR 15	ノルマルパラフィン	92	252 ~ 272	○	4
実施例 10	J	エクソールD110	パラフィン/ナフテン混合	82	243 ~ 272	○	3
実施例 11	K	エクソールD130	パラフィン/ナフテン混合	90	277 ~ 310	○	3
比較例 1	L	IPソルベント1816	イソパラフィン	72	73 ~ 140	×	3
比較例 2	M	アイソパーV	イソパラフィン	96	274 ~ 314	×	4
比較例 3	N	IPソルベント2835	イソパラフィン	104	277 ~ 353	×	4
比較例 4	O	エクソールD30	パラフィン/ナフテン混合	84	141 ~ 164	×	2

[0041] (A table 1) is the list of the physical-properties value of the solvent in the examples 2-11 and the examples 1-4 of a comparison which are shown an example 1 and henceforth, and the assessment results of printing and an odor.

[0042] When the record frequency which a with an optical density of 1.4 or more dot can print at the less than 0.05% as a commercial ink jet printer with the same probability of occurrence of a dot omission was 2kHz or more, they were O (especially good) and 1kHz or more less than 2kHz and the term of printing assessment here was not able to perform O (good), 1kHz or less, or stable printing, it was made into x (defect). The term of an odor shows the result of the four-step assessment in the above-mentioned organic-functions assessment, and can be judged that the case of three or more is good. The assessment conditions of the above-mentioned printing assessment, an odor, and a color-material fixing condition are the same also about

the following examples 2-11 and examples 1-4 of a comparison.

[0043] (Examples 2-6) Instead of mull KAZORU R in the ink A of an example 1 Shell ZORU 70 (trade name) made from shell JAPAN, the IP solvent 1620 (trade name) made from the Idemitsu petrochemistry, Ink B, C, D, E, and F was produced like the example 1, using respectively shell ZORU 72 (trade name) made from shell JAPAN, eye SOZORU 400 (trade name) made from the Nippon Oil chemistry, and Isopar M made from Exxon chemistry (trade name) as a solvent. Each of these solvents is isoparaffin 100%.

[0044] Each ink B-F had the volume resistivity of 107 or more ohm-m, and high F-potential like Ink A.

[0045] The result of having performed the same printing assessment as the aniline point of each solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about ink B-F. Thus, it had the good property like [any ink] Ink A. Moreover, also when which ink was used, color-material fixing in the record electrode point of the ink jet head after printing assessment did not have *****.

[0046] (Examples 7-9) Ink G, H, and I was produced like the example 1, using respectively the no pars 12, 13, and 15 (trade name) which are normal paraffin 100% [made from Exxon chemistry] solvents as a solvent. Each of these ink had the volume resistivity of 107 or more ohm-m, and high F-potential like Ink A.

[0047] The result of having performed the same printing assessment as the aniline point of each solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about ink G-I. Thus, the property with any good ink was shown. However, Ink I has a low regurgitation frequency compared with less than 2kHz and the above and other examples, and can consider viscosity lifting of the ink by having used the solvent with a high boiling range as this cause. Moreover, also when which ink was used, color-material fixing in the record electrode point of the ink jet head after printing assessment did not have *****.

[0048] (Examples 10 and 11) Instead of mull KAZORU R in the ink A of an example 1, Ink J and K was produced like the example 1, using respectively EKUSORU D110 and D130 (trade name) which is the paraffin / naphthene partially aromatic solvent made from Exxon chemistry as a solvent. Each of these ink had the volume resistivity of 107 or more ohm-m, and high F-potential like Ink A. The result of having performed the same printing assessment as the aniline point of each solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about Ink J and K. Thus, although it had the property with any good ink, as compared with the example 1, the response frequency was low. It is thought that this is based on viscosity lifting of the ink by having used the solvent with a high boiling range like the case of Ink I. An odor is considered that an odor is a little strong as compared with ink A-I using an isoparaffin solvent or a normal paraffin solvent, and this is because the amount of a lot of naphthenes exist in a solvent. Moreover, most affixes were not checked by the record electrode point of the ink jet head after printing assessment also when which ink was used.

[0049] (Example 1 of a comparison) Instead of mull KAZORU R in the ink A of an example 1, Ink L was produced like the example 1, using as a solvent the IP solvent 1620 (trade name) which is an isoparaffin 100% [made from the Idemitsu petrochemistry] solvent.

[0050] Ink L all had the volume resistivity of 107 or more ohm-m, and high F-potential like Ink A.

[0051] The result of having performed the same printing assessment as the aniline point of a solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about Ink L. Thus, in Ink L, a good printing result was not obtained but the fixing object was further checked by the record electrode point of the ink jet head after printing assessment. Moreover, as compared with ink A-I using the isoparaffin system which has a boiling range 150 degrees C or more, or a normal paraffin system solvent, the odor was sensed strong a little.

[0052] (Examples 2 and 3 of a comparison) Instead of mull KAZORU R in the ink A of an example 1, Ink M and N was produced like the example 1, using respectively the IP solvent 2835 (trade name) which are Isopar V (trade name) which is an isoparaffin 100% solvent made from Exxon chemistry, and an isoparaffin 100% [made from the Idemitsu petrochemistry] solvent as a solvent.

[0053] Ink M and N all had the volume resistivity of 107 or more ohm-m, and high F-potential like Ink A.

[0054] The result of having performed the same printing assessment as the aniline point of each solvent, a

boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about Ink M and N. Thus, although any ink was good about the odor, a good printing result was not obtained. when this had too high aniline point and boiling range of a solvent, the viscosity of ink became high too much – it is thought that it comes out. Also when which ink was used, color-material fixing in the record electrode point of the ink jet head after printing assessment did not have *****.

[0055] (Example 4 of a comparison) Instead of mull KAZORU R in the ink A of an example 1, Ink O was produced like the example 1, using as a solvent EKUSORU D30 (trade name) which is the paraffin / naphthene partially aromatic solvent made from Exxon chemistry. Ink O all had the volume resistivity of 107 or more ohm-m, and high F-potential like Ink A.

[0056] The result of having performed the same printing assessment as the aniline point of a solvent, a boiling range, and an example 1 and assessment of an odor was indicated to (a table 1) about Ink O. Thus, in Ink O, a good printing result was not obtained but the fixing object was further checked by the record electrode point of the ink jet head after printing assessment. Moreover, a good result was not obtained about the odor.

[0057] As the above example and example of a comparison showed, in ink using the hydrocarbon system solvent whose aniline point is 77-92 degrees C as a solvent, there are few odors and they can realize high printing of a response frequency to stability. Moreover, at 150-260 degrees C, if a boiling range uses the hydrocarbon system solvent whose aniline point is 77-92 degrees C, it can realize high printing of especially a response frequency. Furthermore, as such a hydrocarbon system solvent, if normal paraffin or isoparaffins are used, it can lessen [odor / of ink] dramatically. Moreover, the mixture of normal paraffin and isoparaffins does not take explanation to the same thing in this case, either.

DESCRIPTION OF DRAWINGS

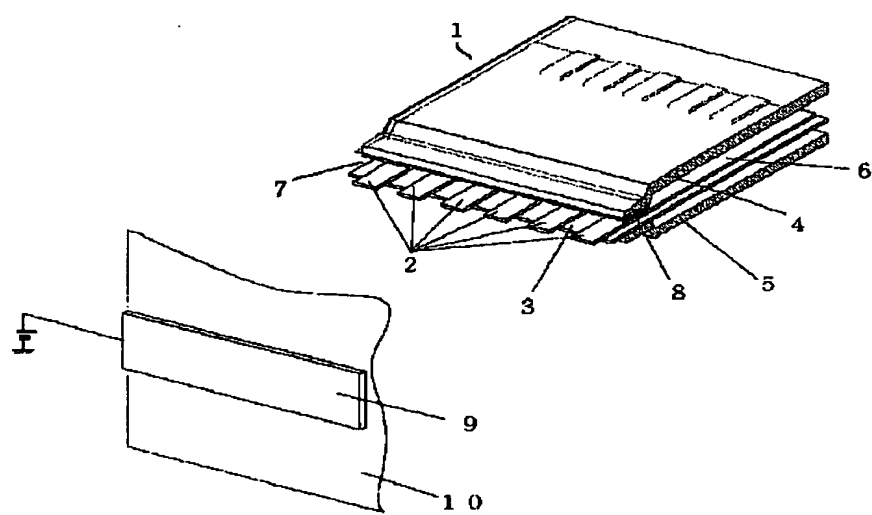
[Brief Description of the Drawings]

[Drawing 1] The perspective view showing the configuration of the electrostatic type ink jet head used for assessment of the ink in this example

[Description of Notations]

- 1 Ink Jet Head
- 2 Record Electrode
- 3 Electrode Substrate
- 4 Head Block Superior Lamella
- 5 Head Block Inferior Lamella
- 6 Ink Restoration Section
- 7 Opening
- 8 Migration Electrode
- 9 Counterelectrode
- 10 Recording Paper

DRAWINGS



[Drawing 1]
